Advances in Healthcare Research
Volume 3, Issue 2 (2025)
Website: https://advancesinresearch.id/index.php/AHR
OPEN ACCESS
e-ISSN: 2985-9808

Formulation and Physical Evaluation of a Combination of Pegagan Leaf Extract (Centella Asiatica L. Urb) and Patchouli Oil (Patchouli Oil) in Liquid Body Wash Preparation

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ARTICLE HISTORY

Received: July 02, 2025
Revised: July 31, 2025
Accepted: August 14, 2025

DOI :
https://doi.org/10.60079/ahr.v3i2.560

ABSTRACT

Purpose: This study aimed to formulate and evaluate the physical quality of liquid body wash containing Centella asiatica (L.). Urb. Extract and patchouli oil to determine the optimal concentration for safe and effective use, with the hypothesis that varying concentrations would affect pH, viscosity, foam stability, and overall product quality.

Research Method: An experimental post-test control design was conducted at the Pharmaceutical Technology Laboratory of Cendekia Utama Kudus Health Technology Institute, with irritation tests performed at Universitas Muhammadiyah Kudus. Four formulations (F0–F3) contained pegagan extract (0%, 5%, 10%, 15%) and patchouli oil (0%, 1%, 2%, 3%). Physical evaluations included organoleptic, homogeneity, pH, viscosity, foam height, and irritation tests. Data were analyzed using Shapiro-Wilk, Levene's test, and One-Way ANOVA.

Results and Discussion: All formulations met SNI standards for liquid soap. Formula 1 (5% extract, 1% patchouli oil) exhibited the most balanced properties, with a neutral pH (6.06), suitable viscosity (695 mPas), stable foam height (13.50 mm), and no irritation. Higher extract concentrations reduced viscosity but did not significantly affect foam height. No formula caused redness or itching in volunteers.

Implications: Formula 1 is recommended for further development as a natural, skin-safe liquid body wash. Future studies should assess the long-term stability, consumer acceptance, and commercial feasibility of these products.

Keywords: centella asiatica, patchouli oil, liquid body wash, physical evaluation, formulation.

Introduction

The skin is one of the most critical components of the human body, functioning to protect the body from physical and mechanical disorders, temperature fluctuations, and various pathogens, including germs and bacteria. Dry skin problems affect millions of people, often causing discomfort and even psychological distress. Clinical symptoms of dry skin include a skin surface that feels tight and stiff, is rough, looks dull, is scaly, itchy, reddish, and can even be painful. Dry skin generally indicates an

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e-ISSN: 2985-9808

abnormality in the stratum corneum of the epidermis. Until now, there has been no internationally recognized definition of dry skin. This condition occurs due to a lack of water in the top 2-3 layers of the stratum corneum, while the layer below remains normal. The stratum corneum contains about 30% water. Dry skin is characterized by a decrease in the water retention capacity of the stratum corneum, with a water content of less than 10%. In this condition, skin function is disrupted, resulting in dehydration. Therefore, choosing the right soap plays a crucial role in maintaining skin moisture and preventing skin dryness (Sari *et al.,* 2017).

Soap is a mixture of various compounds used as a cleaner for dirt, oil, and bacteria, available in both solid and liquid forms. Natural soaps are generally free from synthetic chemicals or artificial additives that can worsen irritation on dry skin. The importance of using natural ingredients that are hydrating is vital for overcoming dry skin health issues. (Reubun & Coal, 2024). Liquid body wash is a very well-known bath soap product and is widely used by the general public. Liquid body wash. It is effective in cleansing and protecting the skin. Liquid body wash has gained popularity due to its ease of use and attractive design, compared to other types of soap. The advantages of liquid body wash include easy carrying, practical storage, and resistance to damage or dirt. Increasing consumer acceptance of liquid body wash. It is not enough to rely only on existing popularity, so additional innovation is needed. One way to achieve this is by incorporating natural ingredients that serve as antibacterials, which are safe for skin health. (Journal *et al.,* 2022)

Nowadays, liquid soap products that use natural ingredients are still hard to find on the market; most still use those made from synthetic ingredients. The purpose of using natural ingredients is to ensure a more hygienic and safe product (Sari *et al.,* 2017). Gotu kola leaves (Centella asiatica (L.) Urb.) can be found among the many natural plants in our environment, known to the public as one of the plants rich in benefits for skin health. (Hadi *et al.,* 2023). Gotu kola plant (Centella asiatica (L.) Urb.) is often used as a natural ingredient to alleviate dry and flaky skin problems. Various skin problems, such as dull skin, wrinkles, and signs of aging, are highly sought after by women who prioritize maintaining the beauty and health of their skin (Hadi *et al.,* 2023). Gotu kola leaves are also known for having potent antioxidant and anti-inflammatory properties (Park, 2018)—these anti-inflammatory properties protect the skin from irritation and reduce skin dryness. Based on the content contained in gotu kola leaves, it has the potential to provide benefits for dry skin health problems (Eka *et al.,* 2023).

Patchouli oil is an essential oil obtained from the patchouli plant through a distillation process. This oil has a distinctive aroma and is used as a natural fragrance in bath soap—the main components of patchouli oil are patchouli alcohol. Patchouli oil is also used as the primary raw material in the perfume industry. Patchouli oil has fixative properties that other oils cannot replace. The use of essential oils in aromatherapy soap ranges from 1% to 7% (Pebri *et al.,* 2019).

Literature Review and Hypothesis Development

Liquid body wash is a liquid cosmetic preparation that functions to cleanse the skin, made from basic soap ingredients with the addition of surfactants, foam stabilizers, preservatives, dyes, and fragrances that are permitted and used as a safe bath soap for the skin. Liquid body wash is not only used as a cleanser, but it is also designed with natural ingredients that can provide benefits such as moisturizing and nourishing the skin (Hamzah *et al.,* 2024). Until now, the use of pegagan herbal ingredients in bath soaps available on the market remains small, but many have added other types of fruits or herbal essential oils as fragrances, such as jasmine, orange, lemon, and mint. The addition of

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pegagan herbal ingredients will provide additional benefits to the quality of the soap, both in terms of aromatherapy and health (Lestari *et al.,* 2021a).

The pegagan plant (Centella asiatica (L.) Urb.) is one of the plants that offers numerous benefits for treatment and skin care. One of them is in the manufacture of liquid bath soap, the pegagan plant is used as an active ingredient because it contains saponin compounds that are beneficial for skin health. (Hasana *et al.,* 2023). Gotu kola plants also contain saponins, asiaticoside, asiatic acid, and madecassoside. Asiaticoside, along with asiatic acid and madecassoside, is a potent antioxidant that can help regenerate tissue levels by stimulating collagen synthesis, thereby cleansing and moisturizing the skin. This property makes it suitable for use as an additional ingredient in liquid soap (Eka *et al.,* 2023).

Patchouli oil has been widely used in the pharmaceutical industry for various products, including topical preparations, perfumes, cosmetics, deodorants, lotions, and soaps. The skin functions to protect against several types of disturbances from external stimuli. In addition to being used in gel preparations, patchouli oil can also be incorporated into soap for its skin health benefits. According to the Indonesian national standard (SNI), soap is defined as a sodium compound with fatty acids used as a body cleanser, in solid form, that foams with or without other additions and does not irritate the skin (Sari Irma, 2022).

Physical Evaluation of Liquid Body Wash Preparation

Liquid body wash preparations are more effective in cleaning dirt that sticks to the skin, both water-soluble and fat-soluble, and remove odors from the skin while providing a long-lasting fragrance. (Dimpudus *et al.,* 2017). Additionally, it must meet several requirements, including a physical evaluation test of the preparation. Physical evaluation is a test conducted to ensure that product quality meets standards. One factor that can affect the physical evaluation of the preparation is the variation in the concentration of the ingredients used in its formulation. Qualitative tests on liquid body wash preparations are conducted through visual observation, including organoleptic tests, homogeneity tests, and irritation tests. First, organoleptic tests are performed to observe changes in shape, color, and odor in liquid soap preparations (Zahro *et al.,* 2023). According to the SNI, the ideal liquid soap standard is characterized by its liquid form, distinctive smell, and specific color (Widyasanti, Rahayu, *et al.,* 2017). Then the homogeneity test is carried out to determine whether the materials used have been mixed well and evenly. Homogeneous preparations can produce good quality because they contain materials that are well dispersed in the base material. The expected result criteria are that there are no lump particles or that the preparation looks uniform (Rusli *et al.,* 2019). The last qualitative test is the irritation test. The irritation test is conducted to assess the potential for skin irritation after the test material is applied, thereby determining the product's safety level (Komang Sumarni & Raya, 2022). The observed parameters include redness, irritation, itching, allergies, and tingling on the skin after the liquid soap formulation is applied. The expected result criteria are to avoid causing irritation effects, such as redness, itchy skin, and roughness, especially on the inside of the hand (Sari *et al.,* 2017).

Quantitative tests on liquid body wash preparations are conducted to generate data in the form of numerical values, including pH tests, foam height tests, and viscosity tests. First, the pH test is carried out using the universal pH indicator method. The pH test is one of the quality requirements for measuring the quality of liquid soap. The pH of soap that is too alkaline can cause the skin to become dry and scaly (Rosmainar, 2021). According to the general SNI standard, the permitted pH range for liquid soap is between 4.0 and 10.0 (Widyasanti *et al.,* 2017). Next is the foam height test, which measures the amount of foam produced. Foam height testing is one method to calculate the stability

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of foam in liquid soap. The higher the foam stability value, the better the quality of the foam produced (Rosmainar, 2021). According to the general SNI standard, the foam height range for liquid soap is 13-220 mm (Widyasanti *et al.,* 2017). Lastly, in the viscosity test, the preparation to be tested is measured for its viscosity (Niah *et al.,* 2023). According to the general SNI standard for liquid soap viscosity, it falls within the range of 400-4000 mPas (Rosmainar, 2021).

Liquid Body Wash Preparation Formulation

One of the cosmetic preparations used daily to cleanse the skin is liquid body wash. The main component in liquid body wash preparations is anionic surfactants (SLS), which function as lipophilic dirt binders and produce foam. The ingredients used in the formulation of liquid body wash preparations in this study were pegagan leaf extract which was used as the main ingredient and patchouli oil which can also be used as a fragrance or aromatherapy, propylene glycol as a moisturizer, sodium chloride as a thickener, methyl paraben as a preservative, sodium lauryl sulfate (SLS) as a foaming agent and citric acid as a pH neutralizer. Liquid body wash, which contains natural ingredients, is not only used as a cleanser but can also help overcome skin health problems such as dry skin, irritation, and others (Darusman *et al.,* 2023). Gotu kola leaves, used as the main ingredient in this study, contain madecassoside, which can help hydrate the skin (Eka *et al.,* 2023). Furthermore, patchouli oil contains patchouli alcohol, which functions as a fragrance to prolong its scent (Pebri *et al.,* 2019). The next component is propylene glycol, which acts as a humectant to help maintain skin moisture (Andini, 2017). Then, sodium chloride, an inorganic salt, functions as a thickener in most cosmetic preparations that contain detergents (Artanti *et al.,* 2021). Citric acid has a practical ability to lower pH and increase product stability and quality. The last component used as a preservative is methyl paraben, as it can prevent the growth of microorganisms in liquid soap preparations, thereby helping to keep the product lasting longer (Sa, 2023).

The Effect of Formulation on the Physical Evaluation of Liquid Body Wash Preparations

The formulation of liquid body wash preparations with variations in the concentration of a combination of pegagan leaf extract and patchouli oil can affect the results of physical evaluations, which include several essential parameters such as organoleptic tests, pH tests, foam height tests, homogeneity tests, viscosity tests, and irritation tests. Organoleptic tests can be affected by variations in concentration, as the higher the concentration of liquid soap in the formula, the greater the consistency, which can result in a slight color change (Khudzaifi *et al.,* 2022). On the other hand, the pH test is influenced by physical factors such as the texture and particle size of the sediment as well as variations in the concentration of pegagan leaf extract (Darusman *et al.,* 2023). The foam height test on liquid soap is influenced by several factors, including the active ingredients of the soap, foam stabilizer, surfactant, and other components, such as the type of oil used (Fanani *et al.,* 2021).

The homogeneity test is influenced by the technique or method used when mixing, as homogeneous preparations can produce high-quality preparations, indicating that the materials used are evenly dispersed. If the preparation material is not evenly dispersed, the results will not be as expected (Safitri *et al.,* 2024). The viscosity test is influenced by concentration. The research by Haikal Rivani et al. demonstrates that formulations with varying concentrations can achieve satisfactory viscosity results (Haikal Rivani *et al.,* 2023). In addition, irritation testing can be influenced by the duration of exposure to the test material; prolonged exposure can lead to adverse skin reactions (Made

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e-ISSN: 2985-9808

et al., 2023), which will later determine consumer acceptance of the product. If all physical evaluation results are adequately met, the liquid body wash product can be considered high quality and safe for use.

In the study by Agustina et al. (2017), the formulation and Evaluation of Liquid Bath Soap with Tomato Extract Were Investigated in formulas of 4% (F1), 5% (F2), and 6% (F3) using Carbopol variations to determine which concentration provides the best viscosity and soap structure. The results of a series of evaluation tests conducted showed that the good viscosity structure of liquid soap was found in F3. This can be seen in the viscosity table, which shows the viscosity value of F3, the closest to that of the liquid soap used for comparison (Agustina *et al.,* 2017).

Research Method

This type of research employs an experimental method with a post-test control design or an observation research design, followed by observation or a post-test. The post-test control design was used to determine the optimal concentration of pegagan leaf extract and patchouli oil in the liquid body wash preparation, which was then physically evaluated to assess the quality of the preparation. Research on the formulation and physical evaluation of liquid body wash preparations from a combination of pegagan leaf extract (Centella Asiatica (L) Urb) and patchouli oil (patchouli oil) was carried out at the Pharmaceutical Technology Laboratory of the Cendekia Utama Kudus Health Technology Institute. The skin irritation test in this study was conducted on students of Muhammadiyah University of Kudus. The population in this study consisted of pegagan leaves (Centella asiatica (L.) Urb.) obtained from UPT. Herbal Materia Medica Laboratory Batu, East Java, and patchouli oil (patchouli oil) online purchases of the Darjeeling Patchouli Essential Oil brand in 30 ml packaging in January. For the population of irritation tests conducted at Muhammadiyah University of Kudus, with respondents aged 15-18 years. The sample used in this study was 500 grams of pegagan plant powder (Centella asiatica (L.) Urb.) extracted with a 70% ethanol solvent at a 1:10 ratio, obtained from UPT. Herbal Materia Medica Laboratory Batu. In this study, the data collection technique uses the observation method. The data analysis method used in this study is a combination of univariate and bivariate analysis.

Results and Discussion

Analysis Result

Plant Determination Results

The plants used in this study were first identified to ensure the authenticity of the plants being studied. The determination process was carried out by matching the morphological characteristics of the plant with the determination key. The determination results showed that the plant used was indeed the pegagan plant (Centella asiatica [L.] Urb.). The authenticity of the researcher's plants was strengthened by the existence of a determination letter issued by the UPT. Batu Herbal Materia Medica Laboratory. The results of plant determination can be seen in the following determination key:

1b-2b-3b-4b-6b-7b-9b-10b-11b-12b-13b-14b-16a-239b-243b-244b248b-249b-250b-266b-267a-268a-269a: Umbelliferae-1b-2b: Centella3: C.asiatica.

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Sample Extraction Results

The process of making thick extracts uses the maceration method. Pegagan leaf powder (Centella asiatica [L] Urb) is weighed in quantities of up to 500 grams, which is then macerated using a 70% ethanol solvent of up to 5 liters. After being macerated for 3 days, the solution is filtered and evaporated using a Vacuum Rotary Evaporator. The evaporation process is continued to obtain a thick extract.

Table 1. Sample Extraction Results

Dry sample weight	Solvent	Consistency of extract	Extract weight	Yield %
Gotu kola leaf powder 500 grams	5 L 70% ethanol	Thick	206 grams	41.2%

Phytochemical Screening Results

Phytochemical screening was conducted to identify compounds contained in pegagan plants, including tests for flavonoids, saponins, and tannins.

Table 2. Phytochemical Screening Results

Class of compounds	Reagent	Results	Information
Flavonoid	Extract + mg + concentrated Hcl	Orange in color	Positive contains flavonoids
Saponins	Extract + hot water	Foam is formed	Positive contains saponins
Tannin	Extract + FeCl3	There is a blackish deposit	Positive for tannin content

Liquid Body Wash Preparation Formulation Results

The results obtained from the four liquid body wash preparations, each with an average weight of 100 ml.

Table 3. Formulation Results

Formula	Concentration of pegagan extract	Patchouli oil concentration
F0	-	-
F1	5%	1%
F2	10%	2%
F3	15%	3%

Results of Evaluation of Preparation and Data Analysis

Organoleptic Test

The results of observations of liquid body wash preparations from four formulas were observed for color, odor, and shape.

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Table 4. Organoleptic Test Results

Formula	Color	Smell	Form
F_0	Clear white	Odorless	Thick liquid
F_1	Chocolate	Typical	Thick liquid
F_2	Dark chocolate	Typical	Semi thick
F_3	Dark chocolate	Typical	Semi thick

Homogeneity Test

A homogeneity test is conducted to determine whether the preparation is homogeneous or not.

Table 1. Homogeneity Test Results

Formula	Results
F_0	Homogeneous
F_1	Homogeneous
F_2	Homogeneous
F_3	Homogeneous

Ph Test

The pH test is carried out to determine the pH value of the preparation, as pH levels that are too acidic or alkaline can irritate the skin.

Table 6. pH Test Results

Formula	pH value		
	Replication 1	Replication 2	Replication 3
F_0	6.07	6.04	6.02
F_1	6.08	6.07	6.03
F_2	6.12	6.13	6.16
F_3	6.16	6.23	6.24

Viscosity Test

The viscosity test is conducted to determine the resistance value of a liquid to flow. The results can be seen in the following table:

Table2. Viscosity Test Results

Formula	Viscosity value (mPas)		
	Replication 1	Replication 2	Replication 3
F_0	1965	1967	1964
F_1	704	694	687
F_2	326	346	345
F_3	262	275	267

Foam Height Test

A foam height test is conducted to determine the height of the foam in the preparation.

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Table 8. Foam height test results

Formula	Foam height value (mm)		
	Replication 1	Replication 2	Replication 3
F_0	13.4	13.3	13.1
F_1	13.6	13.4	13.5
F_2	13.4	13.2	13.5
F_3	13.3	13.6	13.7

Irritation Test

The irritation test is conducted to determine whether the preparation irritates, as indicated by symptoms such as redness, itching, and rough skin.

Table 3. Irritation Test Results

Respondents	Formula							
	F_0(Blank)		F_1 (5%)		F_2(10%)		F_3(15%)	
	X	Y	X	Y	X	Y	X	Y
Respondent 1	-	-	-	-	-	-	-	-
Respondent 2	-	-	-	-	-	-	-	-
Respondent 3	-	-	-	-	-	-	-	-
Respondent 4	-	-	-	-	-	-	-	-
Respondent 5	-	-	-	-	-	-	-	-
Respondent 6	-	-	-	-	-	-	-	-
Respondent 7	-	-	-	-	-	-	-	-
Respondent 8	-	-	-	-	-	-	-	-
Respondent 9	-	-	-	-	-	-	-	-
Respondent 10	-	-	-	-	-	-	-	-

Data Analysis Results

Univariate

Univariate analysis aims to explain or describe the characteristics of each research variable using descriptive statistics (average or mean). The results can be seen in the following table:

Table 4. Descriptive statistical results of physical evaluation

Formula	pH	Average Viscosity (mPas)	Foam height (mm)
F_0(Blank)	6.04	1965.3	13.27
F_1(5%)	6.06	695	13.50
F_2(10%)	6.14	339	13.37
F_3(15%)	6.21	268	13.53

Bivariate

Bivariate analysis using SPSS software with the One-Way ANOVA method, which aims to identify whether there is a significant difference in the concentration of pegagan extract and patchouli oil.

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Table 5. Results of Tests of Normality

	Formula	Shapiro Wilk		
		Statistics	df	Sig
pH Test	F0	0.987	3	0.780
	F1	0.893	3	0.363
	F2	0.923	3	0.463
	F3	0.842	3	0.220
Viscosity Test	F0	0.964	3	0.637
	F1	0.990	3	0.806
	F2	0.787	3	0.085
	F3	0.983	3	0.747
Foam Height Test	F0	0.964	3	0.637
	F1	1,000	3	1,000
	F2	0.964	3	0.637
	F3	0.964	3	0.637

Table 6. Results of Tests of Homogeneity of Variances

	Levene Statistics		df1	df2	Sig
pH Test	Based on the mean	1,360	3	8	0.323
	Based on the median	0.171	3	8	0.913
	Based on median and with adjusted df	0.171	3	4,631	0.911
	Based on the trimmed mean	1,191	3	8	0.373
Viscosity Test	Based on the mean	2,685	3	8	0.117
	Based on the median	0.463	3	8	0.716
	Based on median and with adjusted df	0.463	3	3,558	0.725
	Based on the trimmed mean	2,416	3	8	0.142
Foam Height Test	Based on the mean	0.333	3	8	0.802
	Based on the median	0.100	3	8	0.958
	Based on median and with adjusted df	0.100	3	7,143	0.958
	Based on the trimmed mean	1,313	3	8	0.816

Discussion

This study was conducted to formulate a liquid body wash preparation using Centella asiatica (L.) Urb. (Pegagan) plant samples and patchouli oil. The initial stage of this study began by determining the authenticity of the plant, which was carried out at the UPT. The Batu Herbal Materia Medica Laboratory confirmed that the plant was indeed the pegagan plant (Centella asiatica [L] Urb). The powder of the pegagan leaf simplicia is then extracted using the maceration method. The maceration method is one of the cold extraction methods for soft and heat-resistant samples. This method was chosen because it is simple, allowing for the maintenance of the stability of the compounds contained

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in the simplicia, thereby making them safer.(Indah Sayakti *et al.,* nd 2022). The maceration process is carried out by soaking 500 g of simplisia powder in a glass container containing 5 liters of 70% ethanol. After that, the container is tightly sealed with aluminum foil and stored for 3 days at room temperature, keeping it away from sunlight or lamps. The extract obtained is then evaporated using a rotary evaporator to get a thick extract. The results of the thick extract obtained were 206 grams with a yield of 41.2%. The yield has met the requirements of the Indonesian Herbal Pharmacopoeia, specifically that it is not less than 7.3% (Djoko *et al.,* 2020). The higher the yield value, the greater the extract obtained. This suggests that the efficacious substances in the plant are also more abundant (Nahor *et al.,* 2020).

The extract results were then subjected to phytochemical tests. Phytochemical testing aims to determine the active compounds contained in plants. Phytochemical tests carried out include flavonoids, saponins, and tannins.(Yunus *et al.,* 2018). Phytochemical results show that pegagan plants contain flavonoids, saponins, and tannins. The main flavonoid content of pegagan leaves (Centella Asiatica) is a compound from the flavonol group, with quercetin as one of the most abundant flavonoids. In addition to quercetin, pegagan leaves also contain other flavonoids that act as antioxidants to ward off free radicals (Luh Putu Indah Sari Fatmawati, 2024). Saponin compounds also have natural surfactants that can help form foam in liquid soap (Hadi *et al.,* 2023). The liquid body wash formulation utilizes active ingredients from pegagan leaves and patchouli oil, propylene glycol as a moisturizer, sodium lauryl sulfate (SLS) as a foaming agent, sodium chloride (NaCl) as a thickener, citric acid as a pH neutralizer, and methylparaben as a preservative. For this reason, researchers conducted several tests, namely organoleptic tests, viscosity tests, pH tests, homogeneity tests, foam height tests, and irritation tests.

Organoleptic testing involves observing color, odor, and dosage form, as these factors are closely related to consumer acceptance of the product. Based on the research data on liquid body wash preparations, it is evident that there are differences in color, odor, and shape among the formulas. Formula 0, or blank, has a clear, white color, is odorless, and is in a thick liquid form. This is because the pegagan extract and patchouli oil have not been added. Formula 1 (5%) produces a brown color, has a distinctive odor, and is in a thick liquid form. Formula 2 (10%) produces a dark brown color, has a distinctive odor, and a semi-thick form. Formula 3 (15%) has a dark brown color, a distinctive odor, and a semi-thick consistency. This is because the higher the concentration of the extract, the thicker the color and odor, and the thinner the dosage form.(Hadi *et al.,* 2023). The criteria of this research are based on the established SNI standards because it has a distinctive color, odor, and is in liquid form.

The homogeneity test is conducted to determine whether the liquid body wash preparation contains coarse grains or not, allowing for the observation of whether the soap is well-mixed and homogeneous (Fikriana *et al.*,2023). In this study, the homogeneity test was carried out by applying the sample to a watch glass and then observing its homogeneity. The results of the homogeneity test on the liquid body wash preparation from pegagan extract and patchouli oil showed that no coarse grains were found in each concentration of the fluid body wash preparation, indicating that the base and concentration in each formula were well dispersed. The study's results demonstrate that the preparation meets the requirements established by the SNI standards.

The pH test was conducted to determine the pH value of the liquid body wash produced and to assess its suitability for use as a bath soap. pH is a crucial parameter in making liquid soap, as it comes into direct contact with the skin and can cause problems if the pH is not suitable. The pH test of the fluid body wash was conducted using a pH meter. The tool was then calibrated using distilled water at the start of each treatment. The evaluation results for the preparation, specifically F0 of 6.7, F1 of 6.8,

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e-ISSN: 2985-9808

F2 of 6.12, and F3 of 6.16. This indicates that the four formulas have met the requirements of the SNI 2017 standard, which falls within the range of 4.0 to 10.0. This demonstrates that the study meets the requirements and is safe for use. A pH that is too high can cause skin irritation due to the high free base content. The free base in soap is caused by the presence of an inactive base, which is formed during saponification using fatty acids (Persada Hutauruk *et al.,* 2020).

Viscosity is a crucial parameter in the formulation of liquid body wash preparations, as it impacts quality, comfort, stability, and consumer satisfaction (Eko Wiyono *et al.,* 2020). A viscosity test was conducted to determine the thickness of the preparation using a Brookfield viscometer. In this test, the sample was inserted into a container using spindle number 3 at a speed of 60 rpm. The viscosity value of liquid soap, according to SNI standards, ranges from 400 to 4000 cP. The results obtained in formula 0 (blank) showed a viscosity value of 1,965 mPas, indicating that the preparation is thicker because the extract has not been added, resulting in a high viscosity value. In Formula 1 (5%), the viscosity value is 704 mPas, resulting in a decrease. In formula 2 (10%), the viscosity value is 326 mPas, and in formula 3 (15%), the viscosity value is 262 mPas. The viscosity value decreases. This is due to the difference in extract concentration. The higher the concentration of extract added, the lower the viscosity value.(Eko Wiyono *et al.,* 2020). Viscosity is affected by water content; the higher the water content, the lower the viscosity value. The results of the study showed that the viscosity of liquid body wash decreased with the addition of pegagan extract; however, this study was still within the acceptable SNI standard range, even though formulas 2 and 3 had low viscosity values.

The foam height test is conducted to determine the foam capacity produced in liquid body wash preparations. Stable and long-lasting foam is preferred because foam can help cleanse the body. Foam can be influenced by several factors, namely the presence of surfactants, foam stabilizers, and other soap ingredients (Fanani *et al.,* 2021). Foam height was measured after shaking to determine foam stability. The results of the foam height test, F0 foam height of 13.4 mm, F1 foam height of 13.6 mm, F2 foam height of 13.4 mm, and F3 foam height of 13.3 mm. The results of the study showed that liquid body washes formulated with pegagan extract and patchouli oil can produce good foam in each formula and meet the SNI standard for liquid soap, which is within the range of 13 mm to 220 mm. The results of the foam height measurement indicate the surfactant's ability to form foam. Factors that affect foam height are the sodium lauryl sulfate and saponin in the extract. The higher the SLS and saponin content, the higher the foam obtained (Rahma Fitri *et al.,* 2020).

The irritation test was conducted to determine whether there was an adverse reaction to the liquid body wash preparation of pegagan leaf extract and patchouli oil, such as redness, itching, or rough skin. This test is crucial to ensure that the liquid soap produced is safe and does not cause excessive skin irritation. The irritation test was conducted on 10 volunteers by applying a small amount of the preparation to the hand area, then leaving it for 15 minutes to observe the reaction that occurred. The results of the irritation test on the 0%, 5%, 10%, and 15% formulas showed no adverse reactions, such as redness or itching, in all volunteers. This finding is consistent with research by Lestari et al. (2021), which states that pegagan leaf extract (Centella asiatica [L] Urb.) in solid soap preparations does not irritate. It can be concluded that liquid body wash preparations of pegagan leaf extract and patchouli oil are safe to use.

Univariate analysis aims to determine the characteristics of each formula statistically descriptively (average). Based on the data analysis results, the overall pH value of the formula falls within the range of 6.04 to 6.21. This range falls within the neutral pH category and is suitable for safe liquid body wash preparations. In the viscosity parameter, there is a significant difference between formulas.

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In F0 (blank), the highest viscosity value is 1965.3 mPas, while the lowest viscosity is found in F3 (5%), which is 268 mPas. The decrease in viscosity in F1, F2, and F3 is due to the addition of high concentrations of pegagan extract. The higher the concentration of active ingredients, the lower the viscosity value. The last parameter is the height of the foam, which indicates that the four formulas yield stable results within the range of 13.27 to 13.53 m. This suggests that the addition of pegagan extract and patchouli oil does not have a significant impact on the formation of liquid soap foam. Foam stability is maintained despite variations in the composition of active ingredients. Based on the three evaluations, the favorable pH parameter, with a value of 6.06 in F1, is attributed to the pH being relatively neutral, which is safe for routine use and meets SNI standards. In terms of viscosity, F1 is also included in the good viscosity category, because the viscosity value is still within the recommended range. In the high-foam test, F3 is a good formula because it produces more stable foam compared to the other two formulas.

Bivariate analysis was performed using One-Way ANOVA to determine significant differences between formulas in the physical parameters of liquid body wash. The results of the test of normality using the Shapiro-Wilk method showed that all values were substantial. In each formula and parameter with $p > 0.05$, which indicates that the data are usually normally distributed. Furthermore, the tests of homogeneity of variance using the Levene test showed that all data had a significance value of> 0.05, indicating that the variance between groups was homogeneous. Both of these data results suggest that the data meet the requirements to proceed to the One-Way ANOVA test. The results of the one-way ANOVA test showed significant differences between formulas in pH and viscosity values, with a significance value of $p < 0.001$. This indicates that the addition of pegagan extract and patchouli oil to liquid body wash has a significant effect on changes in pH and viscosity. The results of the foam height analysis yielded a p-value of 0.116 (> 0.05), indicating no significant difference between the formulas. Based on the three evaluations, the author can conclude that Formula 1, with a concentration of 5% pegagan extract and 1% patchouli oil, is the best. This formula has a neutral pH, an appropriate viscosity value, and a stable foam height. Thus, Formula 1 can be used as a good formula in this study.

Conclusion

The results of the study indicate that the liquid body wash formulation made from a combination of Centella asiatica (Centella asiatica [L.] Urb) extract and patchouli oil (patchouli oil) at varying concentrations of 0%, 5%, 10%, and 15% meets the physical quality standards of SNI for liquid soap. Formula 1, with a concentration of 5% Centella asiatica extract and 1% patchouli oil, is the optimal formulation, characterized by a neutral pH (6.06), suitable viscosity (695 mPas), stable foam height (13.50 mm), consistent form and color, and no skin irritation.

Higher extract concentrations tend to reduce viscosity but do not significantly affect foam height. This study suggests that the use of natural active ingredients, such as pegagan extract and nilam oil, can produce a safe, effective, and standard-compliant liquid body wash. These results can serve as a reference for the development of natural-based liquid soap products that not only clean but also have the potential to maintain skin health. These findings also contribute to the literature on natural cosmetic formulations, opening up opportunities for the commercialization of products with skin-friendly and eco-friendly claims.

However, this study has limitations, namely the lack of long-term stability testing, in vivo skin moisturizing efficacy testing, and consumer preference testing. For further research, it is recommended

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to conduct stability testing over different storage periods, additional benefit tests such as moisturizing and antioxidant capabilities, and extensive consumer acceptance analysis. This is important to ensure product quality is maintained and meets market expectations before mass production.

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