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Phytochemical Screening and Organoleptic Evaluation of Local Plant-Based Herbal Shampoo Formulations

[1]*I.M Subrata, [2]I.W.Suanda, [3]A.A.Istri Mirah, [4] N.P.Yuni Astriani Dewi and [5]V. Dada Gole

1. Department of Biology Education, Faculty of Science and Tecnology Universitas PGRI Mahadewa Indonesia*
2. Department of Biology Education, Faculty of Science and Tecnology Universitas PGRI Mahadewa Indonesia
3. Department of Biology Education, Faculty of Science and Tecnology Universitas PGRI Mahadewa Indonesia
4. Department of Biology Education, Faculty of Teacher Training and Education, Universitas Timor
5. Department of Biology Education, Faculty of Science and Tecnology Universitas PGRI Mahadewa Indonesia

*Correspondence email: madesubrata@mahadewa.ac.id

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Abstrak: Penelitian ini bertujuan untuk menganalisis kandungan fitokimia beberapa tanaman lokal serta mengetahui tingkat penerimaan panelis terhadap formulasi sampo herbal berbahan dasar ekstrak tanaman lokal, menggunakan metode deskriptif eksperimental. Sampo herbal diformulasikan menggunakan masing-masing 200 mL ekstrak *Aloe vera*, *Annona muricata* L., *Pogostemon cablin* Benth., *Hibiscus rosa-sinensis* L., dan *Piper betle* L., yang dikombinasikan dengan 120.0 g Texaphon, 40.0 g NaCl, 20.0 mL Camperlan (KD), 10.0 mL Lexain C, 0.4 g asam sitrat, 0.3 g Trilon, 2.2 mL Lexgard P, 2.0 mL pewangi, dan akuades. Skrining fitokimia dilakukan secara kualitatif menggunakan pereaksi spesifik. Uji organoleptik dilakukan terhadap 30 panelis berdasarkan parameter warna, tekstur, aroma, dan sensasi setelah keramas menggunakan skala hedonik. Hasil penelitian menunjukkan bahwa daun sirih mengandung senyawa alkaloid, flavonoid, triterpenoid, fenolik, dan tanin. Daun sirsak, daun nilam, dan daun kembang sepatu mengandung alkaloid, flavonoid, triterpenoid, saponin, fenolik, dan tanin, sedangkan lidah buaya positif mengandung senyawa steroid. Hasil uji organoleptik menunjukkan bahwa formulasi sampo herbal memiliki tingkat penerimaan yang sangat baik, dengan persentase penilaian warna sebesar 85.9%, tekstur 84.1%, aroma 81.7%, dan sensasi setelah keramas sebesar 89.2%. Berdasarkan hasil penelitian, formulasi sampo herbal berbahan tanaman lokal memiliki potensi untuk dikembangkan sebagai produk perawatan rambut alami karena mengandung senyawa bioaktif yang berperan dalam menjaga kesehatan rambut dan kulit kepala serta memiliki tingkat penerimaan konsumen yang tinggi.

Kata kunci: sampo herbal; skrining fitokimia; tanaman lokal; uji organoleptik

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Abstract: This study aimed to analyze the phytochemical compounds of several local plants and to determine panelists' acceptance of herbal shampoo formulations derived from local plant extracts by a descriptive experimental method. The herbal shampoo was formulated using 200 mL each of *Aloe vera*, *Annona muricata* L., *Pogostemon cablin* Benth., *Hibiscus rosa-sinensis* L., and *Piper betle* L. extracts, combined with 120.0 g Texaphon, 40.0 g NaCl, 20.0 mL Camperlan (KD), 10.0 mL Lexain C, 0.4 g citric acid, 0.3 g Trilon, 2.2 mL Lexgard P, 2.0 mL fragrance, and distilled water. Phytochemical screening was conducted qualitatively using specific reagents. Organoleptic testing involved 30 panelists evaluating color, texture, aroma, and sensation after shampooing using a hedonic scale. The results showed that betel leaves contained alkaloids, flavonoids, triterpenoids, phenolics, and tannins. Soursop leaves, patchouli leaves, and hibiscus leaves positively contained alkaloids, flavonoids, triterpenoids, saponins, phenolics, and tannins, whereas *Aloe vera* leaves positively contained steroid compounds. The organoleptic evaluation demonstrated that the herbal shampoo formulation achieved very good acceptance levels, with color scoring 85.9%, texture 84.1%, aroma 81.7%, and sensation after shampooing 80.9%. Based on the findings, the herbal shampoo formulation derived from local plants has promising potential for development as a natural hair care product due to the presence of beneficial bioactive compounds and high consumer acceptance.
Keywords: herbal shampoo; phytochemical screening; local plants; organoleptic evaluation

1. Introduction

Shampoo is one of the most widely used cosmetic products for maintaining scalp cleanliness and hair health. However, most commercial shampoos still contain synthetic chemicals such as sodium lauryl sulfate, parabens, artificial fragrances, and preservatives that may cause side effects, including scalp irritation, hair dryness, allergic reactions, and environmental pollution when used continuously [13].

Herbal shampoos are considered safer because they contain natural bioactive compounds that may provide antioxidant, antimicrobial, antifungal, anti-inflammatory, and cleansing activities beneficial for scalp and hair health [22], environmentally friendly because they are biodegradable and produce lower chemical residues compared to synthetic-based products.

Several local plants contain secondary metabolites such as flavonoids, alkaloids, tannins, phenolics, saponins, terpenoids, and steroids that contribute to maintaining scalp health and improving hair quality [21]. One medicinal plant

widely utilized in hair care formulations is Aloe vera (*Aloe vera* L.). Previous studies reported that aloe vera extract improved the quality of herbal shampoo formulations and increased consumer acceptance due to its ability to soften hair and reduce scalp irritation [2] [4].

Furthermore, explained that aloe vera-based hair care products have the potential to reduce hair loss and improve scalp moisture. Soursop leaves (*Annona muricata* L.) are another medicinal plant containing various secondary metabolites such as flavonoids, alkaloids, tannins, phenolics, and saponins [23]. These compounds exhibit antioxidant and antimicrobial activities that may help inhibit dandruff-causing microorganisms and protect scalp tissues from oxidative stress [17]. Previous studies also demonstrated that soursop leaf extracts have potential as anti-dandruff and anti-lice herbal shampoo ingredients due to their antimicrobial properties [11] [12] [18]. Patchouli leaves (*Pogostemon cablin* Benth.) are well known as aromatic medicinal plants rich in essential oils, has been widely used in perfumes, aromatherapy products, and cosmetic formulations because of its distinctive aroma and antibacterial activities [24]. Research conducted by [10] showed that patchouli oil has potential applications in hair care products because it may reduce dandruff and improve scalp health. [9] also reported that patchouli-based shampoo formulations demonstrated favorable physical characteristics and consumer acceptance.

Hibiscus leaves (*Hibiscus rosa-sinensis* L.) contains flavonoids, tannins, phenolics, and saponins that may contribute to antioxidant and cleansing activities [6]. In addition, explained that hibiscus extract showed potential as a herbal ingredient for reducing hair fall, while reported that hibiscus combined with aloe vera demonstrated beneficial effects in reducing dandruff problems [3] [5]. Betel leaves (*Piper betle* L.) are widely recognized for their antibacterial and antifungal properties due to the presence of phenolic compounds, flavonoids, alkaloids, and tannins [15]. [20] reported that betel leaf extract exhibited effectiveness against head lice, indicating its strong antimicrobial potential in scalp care formulations. Furthermore, [8] explained that phenolic compounds contained in betel leaves contribute significantly to antimicrobial activity in herbal formulations.

2. Research Method

The research focused on identifying secondary metabolites present in selected plant extracts and evaluating consumer acceptance toward the formulated herbal shampoo products. The preparation and formulation of herbal shampoo products were conducted at the Biology Education Laboratory, Universitas PGRI Mahadewa Indonesia.

Phytochemical screening analysis was performed at the RAN Laboratory, Denpasar, Bali. The plant materials used consisted of patchouli leaves (*Pogostemon cablin* Benth.), soursop leaves (*Annona muricata* L.), aloe vera (*Aloe vera* L.), hibiscus leaves (*Hibiscus rosa-sinensis* L.), and betel leaves (*Piper betle* L.). Additional ingredients for herbal shampoo formulation included Texaphon, sodium chloride (NaCl), Camperlan (KD), Lexain C, carbocylic acid (Citrun), Trilon, Lexgard P, perfume, technical methanol, and distilled water. The phytochemical extraction process was initiated by weighing 40 g of each plant sample. The samples were then placed into separate maceration containers and immersed in 200 mL of technical methanol until all plant materials were completely submerged. The maceration containers were tightly closed and stored at room temperature for seven days to allow optimal extraction of secondary metabolites (Table 1).

Phytochemical screening was carried out qualitatively to identify the presence of secondary metabolites, including alkaloids, flavonoids, triterpenoids, saponins, tannins, phenolics, and steroids. Standard phytochemical procedures and specific reagents were used to determine each metabolite group. Alkaloid identification was conducted using Mayer and Dragendorff reagents. Flavonoid compounds were analyzed using magnesium powder and concentrated hydrochloric acid. Saponin compounds were identified based on stable foam formation after shaking. Triterpenoid and steroid compounds were detected using *Liebermann–Burchard reagents,* while tannin and phenolic compounds were analyzed using ferric chloride solution.

Table 1. Formulation of Herbal Shampoo

No.	Ingredients	Amount	Concentration %)
1	*Aloe vera* L. extract	200 mL	20
2	*Annona muricata* L. extract	200 mL	20
3	*Pogostemon cablin* Benth. extract	200 mL	20
4	*Hibiscus rosa-sinensis* L. extract	200 mL	20
5	*Piper betle* L. extract	200 mL	20
6	Texaphon	120.0 g	-
7	Sodium chloride (NaCl)	40.0 g	-
8	Camperlan (KD)	20.0 mL	-
9	Lexain C	10.0 mL	-
10	Carbocylic acid/Citrun	0.4 g	-
11	Trilon	0.3 g	-
12	Lexgard P	2.2 mL	-
13	Parfume	2.0 mL	-
14	Distilled water	1000 mL	-

The combined use of the five extracts also explains the organoleptic characteristics observed in the final product, including color, texture, aroma, foam, and sensation after shampooing. Organoleptic testing was conducted on 30 panelists by applying the formulated shampoo twice a week during the testing period (Table 2).

Table 2. Hedonic Scale for Organoleptic Evaluation

No	Organoleptic Parameter	Hedonic Scale	Numeric Scale
1	Color	Very good	4
		Good	3
		Fairly good	2
		Poor	1
2	Texture	Very good	4
		Good	3
		Fairly good	2
		Poor	1
3	Sensation after shampooing	Very good	4
		Good	3
		Fairly good	2
		Poor	1

The obtained data were analyzed descriptively using percentage analysis to determine panelists' acceptance toward the herbal shampoo formulation. The percentage value was calculated using the following formula:

$$\text{Percentage} = (n/N) \times 100\%$$

Where: n = total score obtained; N = maximum score (highest score × number of panelists)

The organoleptic evaluation used a four-point hedonic scale consisting of very good (4), good (3), fairly good (2), and poor (1). The results were categorized into four criteria based on percentage intervals, namely: very good (81.25–100%), good (62.50–81.25%), fair (43.75–62.50%), and poor (25.00–43.75%) [7]. Based on the calculation results, the percentage intervals were categorized into preference criteria for the organoleptic evaluation, as presented in Table 3.

Table 3. Percentage Interval and Preference Criteria

Interval	Preference criteria
$81.25 < x \leq 100$	Very good
$62.5 < x \leq 81.25$	Good
$43.75 < x \leq 62.5$	Fair
$25 < x \leq 43.75$	Poor

3. Results and Discusion

a. Phytochemical Screening of Local Plant Extracts

The analysis of phytochemical was carried out at the RAN Laboratory Service Unit, Denpasar, Bali. The phytochemical screening results are presented in Tables 4–8

Table 4. Phytochemical Screening of *Aloe vera* Leaves

No	Phytochemical compounds	Reagent	Observation	Conclusion
1	Alkaloid	Meyer	No white sediment	-
2	Flavonoid	HCl+powder of Mg	Yellow	-
3	Triterpenoid	Lieberman-Burchard	ared	-
4	Saponin	Hor water+HCl	No foaming	-
5	Fenolics	$FeCl_3$ 10%	Red	-
6	Tannin	FeCl 1%	Red	-
7	Steroid	Lieberman-Burchard	Red	+

The phytochemical analysis showed that aloe vera leaves positively contained steroid compounds, is widely recognized as a medicinal plant rich in bioactive compounds beneficial for skin and hair treatments. [2] reported that aloe vera contains several phytochemical compounds, including alkaloids,

flavonoids, phenolics, saponins, tannins, and steroids, which contribute to its biological activities.

In cosmetic formulations, aloe vera is frequently used as a natural moisturizer and conditioner due to its soothing properties. [19] explained that aloe vera contains active compounds such as vitamins A, B complex, C, folic acid, lignin, enzymes, and amino acids that are beneficial for scalp and hair health.

Table 5. Phytochemical screening of soursop leaves (*Annona muricata*)

No	Phytochemical Compounds	Reagent	Observation	Conclusion
1	Alkaloid	Meyer	Red solution, white precipitate	+
2	Flavonoid	HCl+powder of Mg	Yellow	+
3	Triterpenoid	Lieberman-Burchard	Brown	+
4	Saponin	Hot water+HCl	Foam form	+
5	Fenolics	$FeCl_3$ 10%	Black	+
6	Tannin	FeCl 1%	Black	+
7	Steroid	Lieberman-Burchard	Brown	-

Annona muricata leaf extract positively contained several important secondary metabolites, including alkaloids, flavonoids, triterpenoids, saponins, phenolics, and tannins. These findings are consistent with previous studies reporting that *Annona muricata* leaves are rich in phytochemical compounds with various biological activities beneficial for scalp and hair health [17].

Alkaloids detected in the extract are known to exhibit antimicrobial and anti inflammatory properties that may contribute to maintaining scalp hygiene and reducing microbial growth on the scalp surface.

The positive presence of triterpenoids and saponins in *Annona muricata* leaves further strengthens their potential utilization in hair care products. The foaming ability observed during the saponin test indicates that soursop leaves may contribute to the cleansing performance of herbal shampoo formulations.

Phenolic and tannin compounds identified in the extract also provide important biological benefits. According to [12], tannins, flavonoids, and saponins found in soursop leaves play significant roles in inhibiting microbial growth due to their antibacterial and antifungal activities.

Table 6. Phytochemical Screening of Patchouli Leaves (*Pogostemon cablin*)

No	Phytochemical compounds	Reagent	Observation	Conclusion
1	Alkaloid	Meyer	Red solution, white precipitate	+
2	Flavonoid	HCl+powder of Mg	Red	+
3	Triterpenoid	Lieberman-Burchard	Brown	+
4	Saponin	Hot water+HCl	Foam forming	+
5	Fenolics	$FeCl_3$ 10%	Black	+
6	Tannin	FeCl 1%	Black	+
7	Steroid	Lieberman-Burchard	Brown	-

The phytochemical screening results demonstrated that *Pogostemon cablin* leaf extract positively contained alkaloids, flavonoids, triterpenoids, saponins, phenolics, and tannins. In addition, patchouli leaves are rich in essential oils, particularly patchouli alcohol, which exhibits antibacterial activity and provides a characteristic natural fragrance [24]. The presence of these bioactive compounds indicates that patchouli leaves have strong potential as herbal shampoo ingredients capable of improving scalp hygiene and enhancing product aroma.

Table 7. Phytochemical Screening of Hibiscus Leaves (*Hibiscus rosa-sinensis*)

No	Phytochemical compounds	Reagent	Observsation	Conclusion
1	Alkaloid	HCl+Reagent Meyer	Red and white sediment forms	+
2	Flavonoid	HCl+powder of Mg	red	+
3	Triterpenoid	Lieberman-Burchard	Brown	+
4	Saponin	Hot water+HCl	Foam form	+
5	Fenolics	$FeCl_3$ 10%	Black	+
6	Tannin	FeCl 1%	Black	+
7	Steroid	Lieberman-Burchard	Brown	-

The phytochemical analysis demonstrated that hibiscus leaves positively contained alkaloids, flavonoids, triterpenoids, saponins, phenolics, and tannins. [6] reported that a hair tonic containing 10% hibiscus leaf extract showed better hair growth activity compared to the positive control treatment using 2% minoxidil.

In addition, hibiscus leaves contain natural mucilage compounds that provide conditioning effects on hair. The mucilage helps soften hair texture, strengthen hair roots, and maintain scalp moisture. [5] explained that hibiscus combined with aloe vera demonstrated positive effects in reducing dandruff problems and improving scalp conditions.

Tabel 8. Phytochemical Screening of Betel Leaves (*Piper betle* Linn.)

No	Phytochemical compounds	Reagent	Observation	Conclusion
1	Alkaloid	HCl+Meyer	Red and white sediment forms	+
2	Flavonoid	HCl+powder of Mg	Red	+
3	Triterpenoid	Lieberman-Burchard	Brown	+
4	Saponin	Hot water+HCl	No foam forms	-
5	Fenolics	$FeCl_3$ 10%	Black	+
6	Tannin	FeCl 1%	Black	+
7	Steroid	Lieberman-Burchard	Brown	-

The phytochemical screening results showed that betel leaves positively contained several secondary metabolites, including alkaloids, flavonoids, triterpenoids, phenolics, and tannins. These findings are consistent with the study conducted by [15], which reported that betel leaves contain flavonoids, essential oils, alkaloids, tannins, and terpenoid compounds with important biological activities. The presence of these phytochemical compounds indicates that betel leaves have significant potential for application in herbal shampoo formulations.

Flavonoids and phenolic compounds found in betel leaves are known to possess antioxidant and antimicrobial activities that may help protect the scalp from oxidative stress and microbial infection. In addition, tannins contribute as natural antimicrobial agents capable of inhibiting the growth of microorganisms associated with scalp disorders. Betel leaves are also rich in essential oils containing natural phenolic compounds with strong antiseptic properties, including bactericidal and fungicidal activities [8].

The presence of bioactive compounds may contribute to maintaining scalp hygiene, reducing dandruff formation, and improving overall scalp health.

Therefore, betel leaves can be considered an important local plant resource for the development of environmentally friendly herbal cosmetic products[21][22].

b. Organoleptic Evaluation of Herbal Shampoo

Organoleptic testing was carried out to determine the level of panelists' acceptance toward the herbal shampoo formulation. The evaluation involved 30 panelists aged 19–26 years who applied the shampoo twice a week during the testing period. The assessed parameters included color, texture, aroma, and sensation after shampooing.

Table 9. Organoleptic Results of Shampoo Color

Color criteria	Number of Panelist	Total Score	Percentage (%) $\left(\frac{\text{Score for each category}}{\text{Ideal maksimal score}} x\ 100\%\right)$
Very good	15	60	50
Good	13	39	32.5
Fair	2	4	3.4
Poor	0	0	0
Total	30	103	85.9

Based on Table 9, most panelists rated the shampoo color as either very good or good, indicating that the visual appearance of the product was generally well accepted. The attractive color of the herbal shampoo may be influenced by the natural pigments derived from the local plant extracts used in the formulation. The high percentage obtained in this study suggests that the herbal shampoo formulation possessed a visually appealing appearance that increased panelists' interest in using the product[23][24].

Table 10. Organoleptic Evaluation of Shampoo Texture

Texture Criteria	Number Panelist	Total Score	Percentage (%) $(\frac{\text{Score for each category}}{\textit{Ideal maximal score}} x\ 100\%)$
Very good	11	44	36.6
Good	19	57	47.5
Fair	0	0	0
Poor	0	0	0
Total	30	101	84.1

Based on Table 10, most panelists assessed the shampoo texture as good and very good, indicating that the formulation possessed an acceptable consistency and was comfortable to apply during shampooing.

The favorable texture of the shampoo may be influenced by the combination of surfactants and natural plant extracts used in the formulation. A good shampoo texture is important because it affects ease of application, foam stability, and consumer comfort during use[25].

These findings suggest that the combination of local plant extracts used in the formulation not only contributed biological benefits but also supported the physical quality of the shampoo product.

The organoleptic evaluation of the herbal shampoo aroma was conducted involving 30 female panelists aged 19–26 years, consisting of Biology Education students and students from several other universities. The results of the aroma evaluation are presented in Table 11.

Table 11. Organoleptic Results of Shampoo Aroma

Aroma Criteria	**Panelist**	**Hight score panelist' pavorit**	**Percentage** $(\frac{\textbf{Score each tiap category}}{\textbf{Ideal maximal score}} \boldsymbol{x}\ \mathbf{100\%})$
Very good	9	36	30
Good	20	60	50
Not good	1	2	1.7
Not good	0	0	0
Total	30	98	81.7

The aroma acceptance score of 81.7% in the present study is also relevant to the inclusion of *Pogostemon cablin* Benth. Patchouli is an aromatic plant that has been investigated for hair and scalp applications. A recent study by [9] found that patchouli oil formulations showed stable physicochemical properties and demonstrated antifungal activity against *Malassezia globosa*. Therefore, the relatively high aroma acceptance observed in the present study may be associated with the aromatic characteristics of patchouli, although this relationship was not directly tested[26].

The organoleptic evaluation after shampoo application was conducted involving 30 female panelists aged 19–26 years, consisting of Biology Education

students and students from several other universities. All panelists fulfilled the testing criteria by using the herbal shampoo twice weekly during the observation period. The assessment results regarding the sensation after shampoo application are presented in Table 12.

Table 12. Organoleptic Results After Using Shampoo

Sensation after using shampoo	Panelist	Hight score panelist' pavorit	Percentage $(\frac{\text{Score each category}}{\textit{Ideal maximal Score}} x\ 100\%)$
Very good	19	36	30
Good	9	57	47.5
Not good	2	4	3.4
Not good	0	0	0
Total	30	97	80.9

Based on Table 12, the results of the shampoo after use show that the average panelist stated that they were happy or interested in using the shampoo, namely 97 with a total score of 80.9%, with the hedonic criterion being like. This indicates that the panelists were attracted to the shampoo because of the pleasant sensation after shampooing.

4. Conclusion

The results of this study indicate that the combination of *Aloe vera* L., *Annona muricata* L., *Pogostemon cablin* Benth., *Hibiscus rosa-sinensis* L., and *Piper betle* L. can be formulated into a herbal shampoo with favorable organoleptic characteristics. Phytochemical screening showed the presence of several secondary metabolites, including alkaloids, flavonoids, triterpenoids, saponins, phenolics, tannins, and steroids, although their distribution varied among the individual plant extracts. The organoleptic evaluation demonstrated good panelist acceptance, with scores of 85.9% for color, 84.1% for texture, 81.7% for aroma, and 80.9% for sensation after shampooing. These findings suggest that the combination of the five local medicinal plants can provide an acceptable herbal shampoo preparation. However, further research is needed to evaluate the quantitative phytochemical composition, physicochemical stability, antifungal activity, and safety of the formulation before its wider application as a hair-care product.

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