Archives of Agriculture and Environmental Science 11(1): 123-127 (2026)
https://doi.org/10.26832/24566632.2026.1101018

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes

ORIGINAL RESEARCH ARTICLE

Evaluation of herbal shampoo formulated using *Gymnocladus burmanicus* and *Dillenia indica* extract

Temin Payum

Department of Botany, Jawaharlal Nehru College, Pasighat, Arunachal Pradesh, India
E-mail: teminpayum519@gmail.com

ARTICLE HISTORY

Received: 09 January 2026
Revised received: 13 March 2026
Accepted: 18 March 2026

Keywords

Clean and green technology
Ecofriendly shampoo
Natural shampoo
Sulfate free shampoo

ABSTRACT

The present work was undertaken under the clean and green technology initiative to provide a natural, ecofriendly healthy shampoo formulation using the natural herbal ingredients. Hair care products like shampoo is one of the fastest growing industry but most of the commercial shampoo is formulated with the ingredients of synthetic components like sodium lauryl sulfates, paraben and silicone, these ingredients are attributed to skin irritation, regular use of these ingredients may even cause tumour therefore these ingredients are harmful to soil, aquatic life and also not environmental friendly. This study was carried out to formulate a natural shampoo by using *Gymnocladus burmanicus*, a natural detergent tree; this natural soap is used in hair wash and also as an anti dandruff among the tribal people of Arunachal Pradesh. Another tree called *Dillenia indica* is used as a hair conditioner in Arunachal Pradesh. For the first time, a natural shampoo is formulated by using ingredients of *G. burmanicus* and *D. indica* in this study. Hot extraction methods were used to extract the biological contents from the plant samples. Various shampoo evaluation parameters including detergency, odour, appearance, colour, foam formation etc. was evaluated in the study as per standard protocols. The natural shampoo formulated was found to be light brown in colour, lemonic in aroma, medium bubble formation, very high in detergency capacity. The result of the formulated shampoo indicates a promising scope in the development of a new and better hair wash for the user as well as for the environmental safety.

Citation of this article: Payum, T. (2026). Evaluation of herbal shampoo formulated using *Gymnocladus burmanicus* and *Dillenia indica* extract. *Archives of Agriculture and Environmental Science*, *11*(1), 123-127, https://dx.doi.org/10.26832/24566632.2026.1101018

INTRODUCTION

Globally, demand for herbal and natural hair care products rocketed because consumers became aware of the possible harmful side effects of synthetic shampoos and prefer green and natural plant based cosmetics. Today products without chemicals are chosen by the modern consumer market because they understand that the natural products made from herbal extracts, essential oils and botanical proteins provide much better hair health benefits in the long term (Vairagade *et al*., 2025). The current cosmetic industry is introducing natural substances to hair products to offer soothing cleansing and nourishment with a minimal reaction (Cruz *et al*., 2016). Hair is one of the most symbolic parts of the human body, at all times and in all cultures. Beyond its aesthetic aspect, it carries a profound meaning, embodying identity, culture, and beauty. The fascination with hair is particularly marked among women, with beauty rituals handed down from time immemorial testifying to its importance (Jihane *et al*., 2025). Hair care industry is one of the fastest growing industry, hair care industry is calculated at the global hair care market size was valued at USD 99.02 Billion in 2025. The industry is expected to grow at a CAGR of 4.20% during the forecast period of 2026-2035 to attain a valuation of USD 149.42 Billion by 2035 and there is a growing preference for hair care products formulated with natural, organic, and non-toxic ingredients (Expert Market Research, 2026). There is increasing need of natural hair care products research and formulation. But most of the hair care products in the markets are

made up of synthetic and harmful chemical ingredients including high percentage of Sulfonates in shampoo. Shampoo is typically used to remove the unwanted build-up of sebum (natural oils) in the hair without stripping out so much as to make hair unmanageable. Shampoo is generally made by combining a surfactant, most often sodium lauryl sulfate or sodium laureth sulfate, with a co-surfactant, most often cocamidopropyl betaine in water. The sulfate ingredient acts as a surfactant, trapping oils and other contaminants, similarly to soap. But these ingredients may even cause tumour, skin irritation as well as harmful to environment including soil and aquatic life; The prolonged exposure on such detergents can be toxic not only on environment but also to the surfaces of human and metals. Traditional synthetic surfactants used in shampoos, such as sodium lauryl sulfate (SLS), raise significant environmental and dermatological concerns due to their poor biodegradability, high irritation potential, and petrochemical origin. While the role of surfactants in shampoos is well-established, their environmental drawbacks—especially in terms of Eco toxicity and persistent residues—necessitate a shift toward greener alternatives (Bezerra *et al*.,2023). Synthetic surfactants, while effective in cleaning, pose significant environmental concerns due to their persistence, toxicity, and contribution to water pollution. Many conventional surfactants, such as sodium lauryl sulfate (SLS) and sodium laureth sulfate (SLES), are derived from petrochemicals, making them non-renewable and contributing to carbon emissions during production (Nagtode *et al*., 2023). There is, therefore, an unmet need in the art of shampoo formulation and composition that is user friendly and ecofriendly. Biosurfactants is an alternative as it offers eco-friendly, skin-compatible alternatives that align with green chemistry principles and support sustainable personal care (Shaziya *et al*., 2025). Biosurfactants reduce surface tension and form micelles, allowing the removal of oil, dirt, and particulate matter from hair. It is effective in sebum removal (85–95 %) in shampoo matrices, comparable to SLS (Samadi *et al*., 2025). Fortunately, Nature has endowed the earth with many natural resources that can be used in the hair care products. *Sapindus mukorossi*, *Yucca Schidigera*, *Quillaja saponaria*, *Saponaria officinalis*, *Aloe ferox* are some of the saponin containing natural plants; these natural sources of saponin have high potential in detergent products and related market. Saponins are natural compounds that act as natural detergent. Various workers have tried to work on the natural detergency and shampoo formulation; fifty-nine plant species are reported to be used as a substitute of soap in Southern African region (Mzimbaa *et al*., 2023). A natural hair shampoo by using the extracts of *Acacia concinna*, *Sapindus mukorossi*, *Phyllanthus emblica*, *Ziziphusspina-christi and Citrus aurantifolia* in different proportions having excellent conditioning performance, at par with commercially available shampoo has been formulated (Al Badi & Khan, 2014). Ahair wash soap contained natural ingredients base soap was also formulated by using natural ingredients (Siddhartha *et al*., 2024); In a review on herbal detergency in which natural ingredients based soap is reported to be better for consumer as well as for market (Pradeep, 2023). Another formulation and evaluation of a polyherbal shampoo using plant-derived ingredients like Hibiscus, Neem, Henna, Amla, Shikakai, Ritha, and Aloe-Vera in which preparation involved creating a decoction and mixing the powders, after which the shampoo was assessed for organoleptic and physico-chemical properties; The resultant herbal shampoo not only cleanses but also conditions hair, promoting health and addressing issues like dandruff and lice while being safer and less allergenic compared to synthetic options (Gudisi, 2025). In the reviewed article of various herbal shampoos, it was found to be more demanding and safe with equal foaming and cleansing capacity (Riya *et al*.,2023). Another work on the formulation and evaluation of herbal shampoo containing *Ficus religiosa* leaves (Powder), Hibiscus Leaves (Powder), Reetha (Powder), Shikakai (Powder), Aloe Vera in which they reported the effectiveness and benefits of herbal shampoo (Sushil *et al*.,2024). Many researchers studied the effectiveness of natural and organic shampoos compared to traditional shampoos and reported the natural shampoo equally effective in cleansing hair and scalp (Abhay, 2023). Sagar *et al.* (2023) also formulated and evaluated herbal shampoo from *Murayya koengi* and reported be effective and acceptable among the users. Also, soap used in cleansing & lubricating products using various natural detergents, they reported to be better for users and well as for environment (Deepika & Deepanshu, 2014). Lakade *et al.* (2026) recently formulated and evaluated herbal soap and Shampoo having antimicrobial property. Herbal shampoo bar as a sustainable alternative to synthetic hair cleanser has been reported to be a sustainable and alternative option over synthetic products (Harshitha, 2025). In an herbal shampoo formulation with natural ingredients including *Sapindus mukorossi* (Reetha), *Emblica officinalis* (Amla), *Azadirachta indica* (Neem), *Aloe barbadensis* (Aloe Vera), *Murraya koenigii* (Curry Leaves), *Ocimum sanctum* (Tulsi), *Trigonellafoenum-graecum* (Fenugreek), *Linum usitatissimum* (Flaxseed), and *Hibiscus rosa-sinensis* (Hibiscus) and found to be useful and effective (Shubhangi *et al*., 2025). A melt and pour herbal cleanser blending *kapok gum*, 20%, musk melon, 10% olive oil, 5%, argan oil, 3%, soap base, 90% was formulated and found to be very effective in hair cleansing (Chandira *et al*., 2022). Natural cleanser is clinically effective and less toxic and more biodegradable in aquatic organisms and human skin cells than synthetic detergents (Takahide *et al*., 2025). Plant surfactants are more ecofriendly and should be a must ingredient in detergency formulation for a sustainable development in which various utility of plant surfactants is discussed (Káren *et al*., 2023). Formulation of herbal soap and shampoo is reviewed to be and reported more sustainable and desirable (Nikita *et al*., 2025). The biosurfactants derived from plants are bestowed with many characteristic features such as natural abundance, renewability, sustainability, lower cost, superior stability, biocompatibility, biodegradability, low environmental and human toxicity when compared with synthetic surfactants (Aruna, 2023), in this work on the natural detergent plants from India, *Sapindus* sp. and *Acacia concinna is included.* Besides all reviewed literature, no shampoo formulation work on *G. burmanicus* has been reported till date. *G. burmanicus* is natural detergent tree. The tribal people of

Arunachal Pradesh use the pod of *G. burmanicus* as raw shampoo without any further process and formulation. *Gymnocladus* is a small genus of leguminous trees. *G. burmanicus* tree is known as Dikang or Dika in Arunachal Pradesh, India grows at altitudes from 350 m to 700m. *G. burmanicus* and extract has cleansing property and contains saponins; Saponins are anti-bacterial, and anti-fungal, among others, and it provides a less irritating alternative to non-natural chemical formulations. Saponins are natural surfactants and have a diverse range of properties, including foaming, cleaning and activities. Saponins are amphipathic glycosides comprising one or more hydrophilic glycoside moieties combined with a lipophilic triterpene derivative. This present work is a natural shampoo formulation by using extract of *G. burmanicus* and *Dillenia indica*. This study aimed to provide a cleaning composition comprising of naturally occurring detergent that is cost effective, safe to user, safe to environment and easy to manufacture and completely free of toxic substances. The aim of this study was to formulate an herbal shampoo which is at par with the synthetic shampoo available in the market.

MATERIALS AND METHODS

Collection of materials

The study was carried out in the laboratory of the Department of Botany, Jawaharlal Nehru College, Pasighat Arunachal Pradesh. The pod of *Gymnocladus burmanicus* were collected from Ledum village of Arunachal Pradesh and the fruit of *Dillenia indica* were collected from Sille village of Arunachal Pradesh, Chemicals, glass ware and instruments from the Department of Botany, Jawaharlal Nehru College, Pasighat with the support from the Department of Biotechnology, Institutional Biotech Hub project implemented at the Department of Botany, Jawaharlal Nehru College, Pasighat were used in the studies.

Preparation of *G. burmanicus* and *D. indica* extract

The *G. burmanicus* and *D. indica* fruits were cleaned by using soft brush, then rubbed the pod with wet clothes and finally washed thoroughly in distilled water and chopped. The chopped materials were allowed to dry under shade. *G. burmanicus* fruits and *D. indica* fruits were soaked in distilled water separately for twenty -four hours in a ratio of 1:1 in 1litres capacity conical flask with cotton plug and filtered by using Whatmann filter paper no. 40, separately. The solutions obtained were evaporated in water bath till the slurry dark brown extracts were achieved, the *G. burmanicus* extract was marked as sample A and the *D. indica* extract was marked as sample B. These extracts were used in the shampoo formulation.

Preparation of shampoo

In a 20g *Gymnocladus* pod extract, 20g *Dillenia* fruit extract was added in a beaker then distilled water was added to make the final weight at 100g. These mixtures were stirred vigorously to get a solution. Thereafter, in a separate vessel, 10g Xanthan gum was taken and the mixture solution of *Gymnocladus*, *Dillenia* and water was slowly added into the vessel containing Xanthan gum with vigorous stirring to obtain a gel product. It was further added with one drop of lemongrass oil, the pH of the solution was adjusted at 7.1 by adding 1% citric acid solution and bottled in 100 ml capacity container and used in the evaluation of the formulated shampoo.

Evaluation of formulated shampoo

To evaluate the quality of prepared formulations, several parameter tests were carried out as per the protocol given in Al badi & Khan (2014) and Ashok & Rakesh (2010) in addition to other protocol mentioned under related tests.

Physical appearance/visual inspection

The formulated shampoo was evaluated for the clarity, color, odor and foam producing ability (Aghel *et al*., 2007).

Determination of pH

The pH of shampoo was measured by using pH meter at room temperature (Tarun *et al*., 2014).

Determination of % of solid contents

6 grams of shampoo was taken in a clean and dry evaporating dish. The shampoo was evaporated on hot plate. The % of the solid contents of shampoo left after complete drying was calculated.

Dirt dispersion test

Fourdrops of shampoo were added to 20 mL of distilled water in a test tube. One drop of ink was added to this shampoo and shaken ten times. The amount of ink in the foam was recorded; such as none, light, moderate or heavy (Ali & Kadhim, 2011).

Foam test

To evaluate foaming ability and foam stability, 20 mL of shampoo was taken in test tube and shaken 10 times. The volume of foam content after 1 min of shaking was recorded (Klein, 2004).

Evaluation of conditioning performance

Hair tress was collected from a local salon of Pasighat market. The tresses were soaked in the formulated shampoo. 5 g of a sample and 5 g of water was taken in a conical flask and hair tress were soaked for 2 min and then rinsed with water and dried at room temperature. The conditioning performance of the shampoos i.e. smoothness and softness, was evaluated by a blind touch test, administered to ten blind folded student volunteers (Boonme *et al*., 2011). All the students were asked to touch and rate the four tresses for conditioning performance from score 1 to 4 (1 = poor; 2 = satisfactory; 3 = good; 4 = excellent).

RESULTS AND DISCUSSION

Formulation of herbal shampoo

The herbal shampoo was formulated by using extracts of *G. burmanicus*, *D. indica* fruit in definite amount as shown in Table 1. *G. burmanicus* is a natural detergent and antidandruff plant that

Table 1. Ingredients used for the preparation of herbal shampoo.

Ingredients	Weight (g)
G. burmanicus	20
D. indica	20
Xanthan	10
Water	50
Lemongrass oil	One drop
Citric acid	Two drops

Table 2. Physicochemical parameter of formulated herbal shampoo.

Colour	Light brown
Transparency	Clear
Odor	Lemon
pH	7.1
Solid content (%)	15
Foam type	small
Detergency	Good
Conditioner	Light dry

contain detergency saponin with foaming properties. *D. indica* is a hair conditioning agent that gives hair conditioning. A good shampoo must have adequate viscosity and Xanthan gum was used in this formulation to give pseduoplastic character (Al Badi & Khan, 2014). Citric acid was added to adjust the pH. Lemon grass oil was added to give lemonic aroma. Final formula of the prepared shampoo is presented in Table 1.

Physical appearance/visual inspection

A shampoo should have good appealing physical appearance to appear the user and marketable. The formulated shampoo as evaluated for physical characteristics such as color, odor and transparency (Table 2). The prepared shampoo was transparent, light brown and had lemonic aroma.

pH

Most shampoos are formulated to alkaline to minimize the damage to hair. The slightly alkaline shampoo enhances the qualities of hair and maintains manageable hair (Al Badi & Khan, 2014). The pH of formulated shampoo was recorded at 7.1.

Solid contents

A good shampoo usually has some solid content at around 15%; it is easy to be applied and rinse the hair. The percent of solid content of the tested shampoo was found to be16% (Table 2).

Foaming stability

Foaming is one of the very important characters of a shampoo to the user. The foaming of the formulated shampoo was recorded to be medium, compact, uniform, dense and stable.

Conditioning performance

A high conditioning shampoo gives plus points to the user in addition to the ability to clean oil and dirt and makes better marketing scope of a shampoo. The score of the conditioning performance of the formulated shampoo was found to 2 out of 4. Manikar & Jolly (2001) reported the formulation of natural shampoo using the herbal ingredients. Also, Shubhangi *et al.* (2025) reported the formulation and proximate composition of natural shampoo using herbal ingredients.

Conclusion

The shampoo was formulated by using plant extract of *G. burmanicus* pod, which is traditionally used as hair wash andan anti-dandruff haircare in Arunachal Pradesh. *D. indica* fruit is used as a hair conditioner among the local people of Arunachal Pradesh, the extract of *D. indica* was used to give a conditioning shampoo. All the ingredients used to formulate shampoo are safer than Sulfates, paraben and silicon that are frequently used in the synthetic shampoo in view of user as well as for the environment. Several parameters were followed to evaluate the physicochemical properties of the formulated shampoo. The prepared shampoo showed promising result to be studied further for commercialization in future with improvement for overall quality. This research enriches herbal shampoo studies and scope, emphasizing the necessity of the further studies of herbal shampoo in relation to the user and environmental friendly shampoo development.

ACKNOWLEDGMENT

The authors would like to acknowledge the support of Department of Biotechnology, Government of India for partly using the facility and consumable items from the Institutional Biotech Hub Project; Project number No. BT/NER//143//sp44402/2021 implemented at Jawaharlal Nehru College, Pasighat, Arunachal Pradesh, India for the facility.

DECLARATIONS

Author contribution: Conceptualization, Collection of materials, Data generation, draft preparation and all other related contribution of the manuscript was carried out by the author (T.P.). The author has read and agreed to the published version of the manuscript.

Conflicts of interest: The author declares no conflict of interest.

Ethics approval: This study did not involve any animal or human participant and thus ethical approval was not applicable.

Consent for publication: The author gave consent to publish this paper.

Data availability: The data that support the findings of this study are available on request from the corresponding author.

Funding statement: Not applicable.

Supplementary data: No supplementary data is available for the

paper.

REFERENCES

Abhay, T. (2023). The effectiveness of natural and organic shampoos compared to traditional shampoos. *International Journal of Novel Research and Development*, *8*(3), 2456-4184.

Aghel, N., Moghimipour, B., & Dana, A.R. (2007). Formulation of a herbal shampoo using total saponins of *Acanthophyllum squarrosum*. *Iranian Journal of Pharmaceutical Research*, 6(3), 167. 172.

Al Badi, K., & Khan, S.A. (2014). Formulation, evaluation and comparison of the herbal shampoo with the commercial shampoos. *Benu Suef University Journal of Basic and Applied Sciences*, *3*, 301-305. https://doi.org/10.1016/j.bjbas.2014.11.005

Ali, H, S., & Kadhim, R, B. (2011). Formulation and evaluation of herbal shampoo from *Ziziphusspina* leaves extract. *International Journal of Research in Ayurveda & Pharmacy*, *2*(6), 1802-1806.

Aruna, J. Kora. (2023). Plant saponin biosurfactants used as soap, hair cleanser, and detergent in India. *Applications of Next Generation Biosurfactants in the Food Sector*, 459-477.

Ashok, K., & Rakesh, R.M. (2010). Evaluation of prepared shampoo formulations and to compare formulated shampoo with marketed shampoos. *International Journal of Pharmaceutical Sciences and Review*, *3*(1), 120-126.

Bezerra, K., Meira, H., & Veras, B. (2023). Application of plant surfactants as cleaning agents in shampoo formulations, *Processes*, *11*(3), 879. https://doi.org/10.3390/pr11030879

Boonme, N., Pakpayat, N., Yotmanee, K., & Maneenuan, D. (2011). Evaluation of shampoos containing silicone quaternary microemulsion. *Journal of Applied Pharmaceutical Science*, 01(1), 59-63.

Chandira, R. M., Lokeshwaran, S., & Gladin, S. G. (2022). Formulation and evaluation of herbal soap by using melt and pour method. *Indian Journal of Natural Sciences*, *13*, 44244-44252. https://tnsroindia.org.in/JOURNAL/issue72/ISSUE%2072%20FULL%20TEXT%20PART%2004-%20NEW.pdf

Cruz, C.F., Costa, C., Gomes, A.C., Matamá, T., & Cavaco-Paulo, A. (2016). Human hair and the impact of cosmetic products. A review on cleansing and shape-modulating cosmetics. *International Journal of Cosmetic Science*, *38*(1), 3–13. https://doi.org/10.3390/cosmetics3030026

Deepika, P., & Deepanshu, S. (2024). Soap used in a various of cleansing & lubricating products. *International Journal of Novel Research and Development*, *9*(6), 2456-4184.

Expert Market Research. (2026). Available at: https://www.expertmarketresearch.com/reports/hair-care-market.

Gudisi, R. K. (2025). Development and assessment of natural herbal shampoo: A botanically based approach. *International Journal of Pharmaceutical Sciences*, 3 (1), 2332-2344.

Harshitha, R. (2025). Herbal shampoo bar as a sustainable alternative to synthetic hair cleanser: a review, *International Journal of Novel Research and Development*, *12*(10), 2454-2237.

Jihane, B., Sara, O, A., Zhor, Z., Karima, S.,& Mariame, M. (2025). Preconceived ideas in hair care. *International Journal of Women's Dermatology*,11(2), e194. https://doi.org/10.1097/JW9.0000000000000194

Káren, G. O. et al. (2023). Application of Plant Surfactants as Cleaning Agents in Shampoo Formulations. *Processes*, *11*, 879. https://doi.org/10.3390/pr11030879

Klein, K. (2004). Evaluating Shampoo Foam. *Cosmetics & Toiletries Magazine*, *119* (10), 32-35.

Lakade, M. P., Kirwale, S. V., Jaware, P., Kamble, K., & Pundkar, A. (2026). Formulation and evaluation of antimicrobial herbal soap. *International Journal of Novel Research and Development*, *11*(2), 2456-4184.

Manikar, A. R., & Jolly, C. I. (2001). Formulation of Natural shampoos. *International Journal of Cosmeti Science*, *23*(1), 59-62. https://doi.org/10.1046/j.1467-2494.2001.00057.x

Mzimba, N.F., Moteeteeb, A., & Vuuren, S. (2023). Southern African plants used as soap substitutes; phytochemical, antimicrobial, toxicity and formulation potential. *South African Journal of Botany*, 163,673-68.

Nagtode, V. S., Cardoza, C., & Yasin, A. (2023). Green surfactants (biosurfactants): a petroleum-free substitute for sustainability-comparison, applications, market, and future prospects. *ACS Omega*, *8*(13), https://doi.org/10.1021/acsomega.3c00591

Nikita, P., Atul, Bisen., & Surendra, P. (2025). Review on formulation and evaluation of herbal soap, *World Journal of Biology Pharmacy and Health Sciences*, 21 (02), 572-581.

Pradeep, D. (2023). Herbal Soap- Trends, Benefits and Preparation: A Review. *Acta Scientific Nutritional Health*,7(9), 10-15.

Riya, S. P., Siddhi, S. P., Momin, A. H., & Dipesh, P. P. (2023). A review article on herbal shampoo. *International Journal of Creative Research Thoughts*, *11*, 2220-2224.

Sagar, S. M., Shete, S. S., Bhausaheb, S. G., Sul, S. A., & Santosh, J. (2023). Formulation and evaluation of herbal shampoo from *Murayyakoengi*. *International Journal of Novel Research and Development*, (5), 2456-4184.

Samadi, S., Moradi, M., & Zareei, M. (2025). Development of shampoo formulations using plant/microbial biosurfactants as an alternative to shampoos formulated with harsh synthetic surfactants. *Journal of Surfactants and Detergent*, *28* (3), 463-478, https://doi.org/10.1002/jsde.12814

Siddhartha, D., Sejal, A., Sudipta, S., Muskan, K., & Rajat, D. (2024). Formulation and evaluation of herbal soap. *Journal of Pharmacognosy and Phytochemistry*, 13 (4), 14-19, https://doi.org/10.22271/phyto.2024.v13.i4a.14990

Shaziya, Y., Sayeed., & Goyal, A. (2025). Eco-friendly biosurfactants in shampoo: Green chemistry innovations for sustainable personal care. *Journal of Dermatologic Science and Cosmetic Technology*,2(3), 100105.

Shubhangi, M. L., Mohini, T. L., & Shital, K. (2025). Formulation and evaluation of herbal shampoo using natural ingredients. *International Research Journal in Modernisation Engineering Technology and Science*, *07*(05), 1888-1890.

Sushil, K. P., Shashank, T., Sunil, M., & Sachit, S. (2024). Formulation and evaluation of herbal shampoo. *International Journal of Life Science Research Archive*, 07 (02), 043–057.

Takahide, K., Akihiro, M., Takayoshi, K., Hayato, & Sadanori, A. (2025). Natural soap is clinically effective and less toxic and more biodegradable in aquatic organisms and human skin cells than synthetic detergents. *PLOS One*, https://doi.org/10.1371/journal.pone.0324842

Tarun, A., Tarun, J., Susan, J., Susan, V.J., & Criton, S. (2014). Evaluation of pH of bathing soaps and shampoos for skin and hair care. *Indian Journal of Dermatology*, *59*(5), 442-444. https://doi.org/10.4103/0019-5154.139861

Vairagade, Y., Vaidya, R., & Vavare, P. (2025). A comprehensive review on the formulation, evaluation, and future prospects of herbal shampoo. *International Journal of Pharmaceutical Sciences*, *3*, *3322-3342*. https://doi.org/10.5281/zenodo.15112090