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PREPARATION AND ASSESSMENT OF POLYHERBAL SHAMPOO

Rekha Tarasingh Rajput
Sharda School of Pharmacy, NH-2, Mathura-Delhi Highway, Sharda University, Agra
e-Mail ID: rekhatrajput6@gmail.com
Mobile No.: 9837090955

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ABSTRACT

Background: Shampoos are most likely used for cosmetic purposes. It is a product for hair care and we use it in daily life to clean our hair and scalp. Shampoos are viscid preparations of detergents with appropriate additives, protective substances, and active compounds that are most commonly used as beautifying agents.

Objective: This study aims to prepare and assess polyherbal shampoos with or without SLS for cosmetic purposes from herbal ingredients.

Methodology: The two polyherbal shampoos were formulated in which one was prepared by using SLS and another one was prepared without SLS. The preparation of polyherbal shampoo has two sections, the first section contains, a polyherbal extract prepared by a mixture of Reetha, Amla, Kala siris, Neem, Jatamansi, Bhringraj, Linseed, Aloe vera, and some ingredients. Herb extract of all herbs was added to pestle mortar and mixed properly with a specified quantity of water (A). In the second section, the mortar contains glycerin, propyl glycol, and with or without SLS was stirred gradually (B). Now sample B is mixed by adding it to sample A. Preservative methylparaben was added into it. Pour Aloe vera juice into it and thickness was increased by adding tragacanth gum and making up volume with water. For quality assurance purposes, the developed polyherbal shampoos were also compared with the commercially available shampoos.

Result: These formed polyherbal shampoos are thick semisolid, skin color (F1) and dark brown (F2) with excellent fluidity and foam-producing ability. At 45°C & Room temperature, the pH of shampoos ranges from 6 to 6.5 and the developed polyherbal shampoos are acidic and of high quality.

Conclusion: All evaluation parameters demonstrate that polyherbal shampoos are high quality for use in daily life due to the synergistic effects of herbal ingredients.

Keywords: Polyherbal Formulation, Herbal Shampoo, Shampoo, Development, Formulation.

INTRODUCTION

"Shampoo is the hair and scalp's cleansing preparation[1]. Most likely, Shampoos are utilized as cosmetics.It's a hair treatment formulation that we use daily to clean our hair and scalp.Shampoos are kind of preparation that is used for hair and body wash or therapy. It is expected that shampoo will be more than just a cleaning agent. Besides their detergency effects, Shampoos have several properties such as conditioning and hair shining. They are supposed to be harmless for the mucous membranes and the skin [2]. Shampoo is a viscous solution that contains detergents with appropriate additions, preservatives, and active compounds that are most commonly used as beautifying agents [3]. Hair care products can be characterized as a preparation designed to eliminate excess oil, dirt, and dandruff from the scalp and hair. Products for hair care also nourish hair and give it a healthy appearance. The invention of cake soap and the subsequent development of shampoo products in this century marked the beginning of real technology to clean the hair and scalps[4]. Essentially, these are water-based compounds made primarily of surfactants. Its primary goal is to get rid of sebum accumulation, scalp debris, and hair grooming product residue. In essence, these are water-based compounds made primarily of surfactants. Its primary goal is to get rid of sebum accumulation, scalp debris, and hair grooming product residue [1]. The herbal shampoo is a type of hair care product which uses herbs from plants as an alternative to synthetic shampoos in the market[5].There's a lot of synthetic shampoos on the market right now, both medicated and non-medicated; however, herbal shampoos have gained popularity because they come from nature, which is safer, boosts demand, and has no negative side effects [3].The herbal shampoo will be well-liked by customers despite being safer and performing better than synthetic ones [6].Due to the presence of vitamins, amino acids, sugars, glycosides, phytohormones, bioflavonoids, fruit acids, and essential oils,many natural extracts from plants have beneficial effects on skin and hair and are commonly used in shampoos[7]. The most popular type of hair care method is shampooing. Traditionally, shampoos are products for cleaning scalpsand hair. Certain ingredients of shampoo that have gained popularity among consumers are currently under attackdue to safety concerns (e.g. such as halogenated organic compounds) [8]. Therefore the present study was aims to prepare and assess polyherbal shampoos for hair carepurposeusingnatural ingredients.

MATERIAL METHODS

Plant materials:

Plant Collection and authentication

The drugs weresourced from a local market and verified by Dr. SeemaBhadhauria, the Head of the Botany Department, R.B.S. College, and Agra. A herbarium sheet has been saved for future reference in thePharmacognosy department of Anand College of Pharmacy, Agra (No 49 dated 29.05.2015).

Chemicals and Drugs

Glycerin (Qualigens, Thermo Fisher Scientific India Pvt. Ltd., Mumbai), SLS (Qualigens, Thermo Fisher Scientific India Pvt. Ltd., Mumbai), Propylene glycol (Merck Ltd., Mumbai),Tragacanth Gum (Loba chem., India), Bentonite (Loba chem., India) and other chemicals from local market were used to perform thephytochemical analysis.

Functions of Ingredients

Reetha: *Sapindusmukorossi*, well known as soapnut(Reetha), belong to family Sapindaceae. A common component of Ayurvedic shampoos and cleansers is *Sapindusmukorossi*. In Ayurvedic

medicine, they are used to treat psoriasis, eczema, and freckle removal. Because of their mild insecticidal qualities, soap nuts have long been used to remove lice from the scalp.[9].

Amla:*Phyllanthusemblica* Linn belongs to Phyllanthaceae, is commonly known as Amla. In Indian medicine, amla fruit is commonly used either by itself or in conjunction with other plants to cure fever and common colds, as well as to prevent ulcers and dyspepsia and to function as a laxative, diuretic, liver tonic and hair tonic [10][11].

Jatamansi: Jatamansi is scientifically known as *Nardostachysjatamansi* and well-known for its medicinal properties hence it has been utilized for ages in the Indian Ayurvedic and Greek- Arab Unani traditional medicinal systems. This drug has been shown to have anti-fungal properties[1].

Neem: Its also known as *Azadirachtaindica* belongs to family Meliaceae. Neem extract is also highly effective as a nontoxic antiseptic, insect repellent and pesticide. High foaming properties are also possible in the herbal shampoo in the form of a powder prepared with natural ingredients such as *Ocimum sanctum* and *Azadirachtaindica*[12].

Flax Seed: *Linum usitatissimum* (Linn.) commonly known as flaxseed belongs to the family Linaceae. Flax seed gel can be applied to the scalp and hair like a moisturizer to promote growth of hair and enhance strength of hairs that already exist. Flax seed plant contains ‘lignans’ is another powerful healing ingredient found in the fibrous shell. Lignan is phytohormone precursor that stimulate immune system and has anti-bacterial, anti-fungal properties [13].

Kala Siris: *Albizia odoratissima*, a member of family Fabaceae and commonly known as Kala siris. Numerous classes of secondary metabolites including saponins, terpenes, alkaloids and flavonoids were found in various *Albizia* species when phytochemical investigations were conducted: however, saponins were the primary product of most of these investigations. Its antimicrobial and anti-histaminic properties have been reported [14].

Glycerin: It is stated that glycerin serves as a denaturant, fragrance ingredient, hair conditioner, humectant, oral care product, skin protectant, skin-conditioning agent, and viscosity reducing agent in cosmetics [15].

Sodium Lauryl Sulphate (SLS) :- It is applied as a surfactant[16].

Methylparaben: It is frequently added to foods, medicines and cosmetic products as a preservative, either alone or in combination with other parabens to prevent microbial contamination[17].

Opacifying agents: Higher fatty acid alkanolamides, propylene glycol, stearic acid salts of magnesium, calcium and zinc, spermaceti, etc. are used as opacifying agents [18].

Aloe juice: Aloe has long been used in traditional medicine to treat a variety of conditions, including wound healing, bacterial, viral, and fungal growth inhibition, blood flow enhancement, and anti-inflammatory, anti-aging, and anti-allergic properties. Aloe species extracts and isolates have been shown to possess antimicrobial, antioxidant, and anticancer properties [19].

Preparation of plant extracts

Preparation of Powder and Extract

Take herb, Reetha (Seed), Amla (Fruits), Kala siris (Bark), Neem (Leaves), Jatamansi (Root), and Linseed (Seeds) washed, dried and powdered separately and powder goes through sieve number 80. The amount of different crude drug powders was taken as per table 1.

Table 1: Composition of Crude Drugs used for Preparation of Extracts

S. No.	Plant Name	Plant Part	Amount taken in Grams
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1	Reetha	Seed	30gm
2	Amla	Fruits	10gm
3	Kala siris	Bark	20gm
4	Neem	Leaves	10gm
5	Jatamansi	Root	20gm
6	Linseed	Seed	10gm

Preparation of polyherbal Formulation

Part 1: Preparation of Crude drug Extracts: To prevent deterioration of phytoconstituents, the collected crude drug materials were cleaned and dried in hot air oven at 35⁰C. Plant material was coarsely ground with grinder after drying. Approximately 300 g of the powder in aforementioned ratio were macerated with water for seven days at room temperature in order to extract material. After filtration, the filtrate was collected and concentrated at room temperature [20].

Part -2: Preparation of polyherbal Shampoo: Initially two formulations were developed to find effects of formulation. In both formulations we fix the quantity of methyl paraben, aloe juice and glycerin. We systematically studied the effect of extracts with or without SLS to its synergistic effects. All ingredients were weighed, glycerin (12%), and propyl glycol (5%) were taken in a beaker and heated at 65⁰C by stirring gradually with SLS (25% for Formulation F1) or without SLS for formulation F2 (Phase-1). In the second beaker, Herb extracts (30% & 35% for F1 & F2 respectively) and Methyl Paraben (2.0%) was heated up to 65⁰C and dissolved in water (Phase-2). The phase-1 was gradually added to phase-2 while being continuously stirred, after adding tragacanth (1%) and mixing well till a creamy paste was formed. Pour 5% Aloe vera to it and add sufficient amount of purified water to produce the required volume [21]. General formula used for polyherbal shampoo preparation is mentioned in Table 2.

Table 2: General Formula Used for Polyherbal Shampoos Preparation

Sr. No.	Name of Ingredients	Quantity Taken (100 ml)	
		F1 (Formulation with SLS)	F2 (Formulation without SLS)
1	Extracts	25%	35%
3	Sodium Lauryl Sulphate	25%	--
4	Propyl Glycol	5%	20%
5	Methyl Paraben	2.0%	2.0%
6	Glycerin	12%	12%
7	Aloe Juice	1%	1%
8	Glycerin	1%	1%
9	Tragacanth Gum	1%	1%
10	Distilled Water, sufficient to produce	100ml	100ml

Evaluation of Polyherbal Formulation [21]

Parameters for assessment or evaluation of polyherbal formulations are given in Table 3 and they are:

Physical/visual evaluation:

The prepared polyherbal shampoos were inspected on term of their color is Skin (F1) and dark brown (F2), texture is thick, semi-solid with ability to produce foam and fluidity.

Evaluation of pH:

The pH values for F1 (10%) and F2 (10%) are 6.3 and 6.1, respectively, for 10% polyherbal Shampoo solution in distilled water at 25°C.

Wetting time:

The canvas was divided into 1-inch diameter discs, each weighing 0.34 grams on average. The stopwatch was set to begin when the disc was floated on the 1% w/v shampoo solution surface. And the stopwatch started. The initial time taken by disc to sink was measured accurately and noted as 2 sec wetting time [22].

Skin irritation test: A tiny amount of shampoo can be applied to the skin to test for skin irritancy. After a short while to see if any inflammatory reactions or local irritation are occurring or not [23].

Cleaning action: Five grams of wool yarn were dipped in grease, and then they were submerged in 200 milliliters of water in a flask containing one gram of shampoo. The water's temperature was kept constant at 35. For four minutes, the flask was shaken fifty times per minute. After removing the solution, the sample was removed, dried, and weighed. The following equation was used to compute the amount of grease eliminated.

$$DP = 100(1 - T/C)$$

Where, DP = Percentage of detergency powder and lg, it is weight of sebum in control sample and cleansing action. Polyherbal shampoos are found to be good [21].

Dirt dispersion: Add 10 milliliters of pure water to the test tube. A later step involves adding two drops of shampoo formulation to the test tube. After that, the test tube is filled with one drop of India ink. After that, the test tube is filled with one drop of India ink. After that, the test tube is sealed with a cork and given ten shakes. The findings were indicated by the amount of ink scattered, which may be None, Light, Moderate, or Heavy [24].

Ease of Rinsing: To test how easy it was to rinse hair after using 5 ml of a polyherbal shampoo, researchers applied the shampoo to the hair and noted how long it took to remove foam with water.

Rheological evaluations: A Brookfield Viscometer was used to measure the viscosity of the shampoo at various spindle speeds, ranging from 0.3 to 10 rpm. Using spindle T95, the viscosity of the shampoo was determined. Throughout the investigation, the size of the sample container and temperature were maintained constant [25].

Foaming ability and foam stability: The foaming ability was measured using the cylinder shake method. A 250 ml graduated cylinder was filled with 50 ml of the 1% shampoo solution, covered with a hand, and shaken ten times. Following a minute of shaking, the total quantities of the foam contents were noted. Only the foam volume was computed. As soon as the foam was shaken, the volume was measured 1 minute for four minutes. In 1% of shampoo gives 50 ml and 35 ml foam for F1 and F2 formulation respectively [24].

Measurement of Surface tension: At room temperature, distilled water was used to dilute 10% of a shampoo. Clean the stalagmometer completely with purified water and chromic acid. Since lubricant such as grease have a significant impact on surface tension. Because surface tension is highly affected with grease or other lubricants [26].

Studies on Stability: The formulations, thermal stability was investigated by putting them in glass tubes and keeping them in a humidity chamber with a temperature of Room temperature plus 80% relative humidity and 45°C. For three months, their physical stability and appearance were examined once a month [6].

Statistical Analysis: Every experiment was carried out in triplicate, and the result were reported mean \pm standard deviation. To determine the significance of the difference and the p values, One-way ANOVA was used [7].

RESULTS AND DISCUSSION

The polyherbal shampoos were formulated using extracts of different crudes along with other ingredients and were examined in term of physical appearance, pH, and stability. It seemed that the formulations more stable after keeping it at 45°C and Room temperature. The formulated shampoos were assessed in term of color, clarity, odor, and texture. We did not add any color to the shampoo formulations, but it has a skin color and dark brown hue. The pH of the manufactured shampoo was between 6 and 6.5, which is similar to the pH of the skin as indicated in Table 3. Cuticles, which are microscopic scales, found in hair, are susceptible to pH, particularly an alkaline pH, which causes these scales to open up and cause damage to the hair. Additionally, the mildly acidic pH values of medicinal shampoos may improve hair washing, lessen ocular irritation, and maintain a scalp pH balance that is conducive to the regulation of microbiota [27]. A pH that is somewhat acidic is therefore ideal. Shampoos wetting ability, which is dependent on the surfactant used, characterizes how effective they are as cleaning agents [28]. Shampoo's surfactant content is utilized to lower surface tension. The shampoo's cleaning power increases with decreasing surface tension. If a shampoo can reduce pure water's surface tension from 72.28 dyn/cm to roughly 40 dyn/cm, it is deemed high quality. Their effective detergent action is shown by a decrease in surface tension [29]. These developed formulations had observed good detergent action. Customers believe that a shampoo's ability to froth is crucial to its quality, although there is no connection between foaming and cleaning [30]. Generally, the higher the shear rate, the lower the viscosity, which makes it easier for shampoo to spread on hair [31]. One important consideration when evaluating a shampoo's cleaning efficacy is its degree of dirt dispersion. Product that concentrates ink in the foam degrade in quality due to it is hard to wash out ink or dirt left in foam and found to be redeposited on the hair. A crucial component of shampoo quality that is connected with shampoo's ability to clean is dirt dispersion. Shampoos that cause the foam to retain the ink rather than the liquid part are typically regarded as low-quality goods since it is difficult to remove the ink, which makes it harder to clean the hair debris [32]. The developed formulation had observed no ink in their foam section hence the shampoo formulation proved to be high quality product in term of dirt dispersion-based cleaning action. Finally, the stability data at different conditions show that there was no change in physical appearance was observed and compared with marketed formulations (Antidandruff Shampoo, Himalaya Global Holding Ltd., Bengaluru and Sunsilk shampoo, Unilever global, London. Table 3 provides a summary of evaluation parameters findings.

Table 3: Results of Evaluation of Polyherbal Shampoo

Sr. No.	Evaluation Parameter	Result	
		F1 (With SLS)	F2 (Without SLS)
1	Physical appearance/visual inspection	Skin color	Dark Brown
2	Determination of pH	6.3	6.1
3	Wetting time	2 seconds	2 seconds

4	Rheological evaluations:	1.74cps	1.65cps
5	Foaming ability and foam stability:	50ml	35ml
6	Stability studies	Stable	Stable
7	Nature of Hair after washing	Soft	Soft

CONCLUSION

This study is to successful preparing polyherbal shampoo which contains herbal extracts that is widely used in India for hair cleaning. All ingredients used for shampoo preparation are safer than what is sold on the market and the characterization showed ideal results. Research is still needed to enhance its high-quality checking, particularly with regard to animals and how well they are conditioned.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable

AVAILABILITY OF DATA AND MATERIAL

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are the basis of this research.

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None

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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REFERENCES

- [1] A. Vijayalakshmi, S. Sangeetha, and N. Ranjith, "Formulation and evaluation of herbal shampoo," *Asian J. Pharm. Clin. Res.*, vol. 11, no. Special Issue 4, pp. 121–124, 2018, doi: 10.22159/ajpcr.2018.v11s4.31713.
- [2] G. D. Noudeh, F. Sharififar, P. Khazaeli, E. Mohajeri, and J. Jahanbakhsh, "Formulation of herbal conditioner shampoo by using extract of fenugreek seeds and evaluation of its physicochemical parameters," *African J. Pharm. Pharmacol.*, vol. 5, no. 22, pp. 2420–2427, 2011, doi: 10.5897/AJPP11.121.
- [3] M. Dhanalakshmi, "Formulation and Evaluation of Pitavastatin," *International J of Creative Research Thoughts*, vol. 8, no. 9, pp. 2860–2869, 2013.
- [4] P. R. B., V. P. K., K. V. G., A. N. K., and P. R. K., "A Review on Herbal Shampoo and Its Evaluation," *Int. J. Multidiscip. Res.*, vol. 5, no. 6, pp. 1–13, 2023, doi: 10.36948/ijfmr.2023.v05i06.8673.
- [5] P. Maurya, S. Maury, P. Yadav, M. K. Yadav, and S. Maurya, "a Review Article on : Herbal Shampoo," *Journal of Emerging Technologies and Innovative Research*, vol. 8, no.

- 5, pp. 366–375, 2021.
- [6] K. A. Gaidhani, M. Harwalkar, and P. S. Nirgude, “World Journal of Pharmaceutical Research seed extracts,” *World J. Pharm. Res.*, vol. 3, no. 3, pp. 5041–5048, 2014, doi: 10.20959/wjpr20205-16967.
- [7] H. Umar, T. Mahmood, T. Hussain, R. Aslam, Y. Shahzad, and A. M. Yousaf, “Formulation and In Vitro Characterization of Tea Tree Oil Anti-Dandruff Shampoo,” *Curr. Cosmet. Sci.*, vol. 1, no. 1, pp. 16–25, 2021, doi: 10.2174/2666779701666210426085302.
- [8] S. Saraf, S. M. Hargude, and S. Saraf, “Formulation and Evaluation of Herbal Shampoo Containing Extract of *Allium sativum*,” *Res. J. Top. Cosmet. Sci.*, vol. 2, no. 1, pp. 18–20, 2011, [Online]. Available: www.anvpublication.org
- [9] B. N. Suhagia, I. S. Rathod, and S. Sindhu, “*Sapindus mukorossi* (areetha): An overview,” *Int. J. Pharm. Sci. Res.*, vol. 2, no. 8, pp. 1905–1913, 2011, [Online]. Available: <https://www.researchgate.net/publication/267698560>
- [10] K. V. Kulkarni and S. M. Ghurghure, “Indian gooseberry (*Emblica officinalis*): Complete pharmacognosy review,” *Int. J. Chem. Stud.*, vol. 2, no. 2, pp. 5–11, 2018.
- [11] S. Dasaroju and K. M. Gottumukkala, “Review Article Current Trends in the Research of,” *Int. J. Phara. Sci. Rev. Res.*, vol. 24, no. 2, pp. 150–159, 2014.
- [12] R. M. Al-Mehmadi and A. A. Al-Khalaf, “Larvicidal and histological effects of *Melia azedarach* extract on *Culex quinquefasciatus* Say larvae (Diptera: Culicidae),” *J. King Saud Univ. Sci.*, vol. 22, no. 2, pp. 77–85, Apr. 2010, doi: 10.1016/J.JKSUS.2010.02.004.
- [13] D. Manjula, J. J. L. Jenita, K. B. Premakumari, and S. Banu, “Formulation And Evaluation Of Flaxseed Hair Gel: A Natural Hair Tamer,” *International Journal of Research in Pharmacy and Chemistry*, vol. 8, no. 3, pp. 487–491, 2018.
- [14] S. A. Bahgat D, “Saponins from Genus *Albizia*: Phytochemical and Biological Review,” *Med. Aromat. Plants*, vol. s3, no. June, 2015, doi: 10.4172/2167-0412.s3-001.
- [15] L. C. Becker *et al.*, “Safety Assessment of Glycerin,” *Int. J. Toxicol.*, vol. 38, no. 3, pp. 6S-22S, 2019.
- [16] S. D. Peroukidis, D. G. Mintis, I. Stott, and V. G. Mavrantzas, “Molecular simulation of the morphology and viscosity of aqueous micellar solutions of sodium lauryl ether sulfate (SLEnS),” *JPhys Mater.*, vol. 4, no. 4, 2021, doi: 10.1088/2515-7639/ac0093.
- [17] M. M. Mincea, I. R. Lupşa, D. F. Cinghiţă, C. V. Radovan, I. Talpos, and V. Ostafe, “Determination of methylparaben from cosmetic products by ultra performance liquid chromatography,” *J. Serbian Chem. Soc.*, vol. 74, no. 6, pp. 669–676, 2009, doi: 10.2298/JSC0906669M.
- [18] J. P. P, K. Padmini, J. Srikanth, M. Lohita, K. Swetha, and V. R. P, “A Review on Herbal Shampoo and Its Evaluation,” *Asian J. Pharm. Clin. Res.*, vol. 3, no. 4, pp. 153–156, 2013.
- [19] D. B. Sbhatu *et al.*, “Hair Washing Formulations from *Aloe elegans* Todaro Gel: The Potential for Making Hair Shampoo,” *Adv. Pharmacol. Pharm. Sci.*, vol. 2020, no. 50, 2020, doi: 10.1155/2020/8835120.
- [20] Rekha Tarasingh Rajput, Kashmira J Gohil and Sanjeet Kumar, "Development of Herbomineral Formulation From *Daucus carota* (Linn.) For Wound Healing Effects", *Indian Drugs*, vol. 58, no.07, July, pp. 66–68, 2021.
<https://doi.org/10.53879/id.58.07.12236>

- [21] Utane R, Deo S, and Itankar P, "Preparation of Herbal Shampoo (HS) by Green Method and Their Characterization.," *IJRSSIS*, vol. 5, no. 3, pp. 254–258, 2017.
- [22] Kaur Paninder, Dua J.S, Prasad D.N., "Formulation and Evaluation of Ketoconazole Niosomal Gel," *Asian Journal of Pharmaceutical Research and Development*, vol. 6, no. 5, pp. 71–75, 2018.
- [23] Gouri Kumar Dash and Noor Husna Nazirah Binti A. Razak, "Formulation And Evaluation Of A Herbal Shampoo," *Indo Americal Journal of Pharmaceutical Sciences*, vol. 4, no. 09, pp. 2860–2865, 2017.
- [24] M. S. Bhavani, S. M. Jan, K. S. Rani, and M. Sreirekha, "Formulation, Evaluation and Comparison of the Herbal Shampoo with Commercial Shampoos," *Int. J. Pharm. Sci. Rev. Res.*, vol. 78, no. 1, pp. 2–6, 2023, doi: 10.47583/ijpsrr.2023.v78i01.007.
- [25] P. V. Kumar, P. V. Rao, R. Prince, K. Terejamma, and T. Chaitanya, "Formulation and Evaluation of Herbal Anti-Dandruff Shampoo from Bhringraj Leaves," *ARC J. Pharm. Sci.*, vol. 4, no. 2, pp. 29–33, 2018, doi: 10.20431/2455-1538.0402005.
- [26] K. Vineetha, V. S. Vindhya, M. B. Vishranth, Yashasvi, S. S. Shyam, and A. R. Shabaraya, "Herbal Shampoo : Benefits , Preparation and Evaluation," *J. Xi'an Shiyou Univ.*, vol. 17, no. 09, 2017.
- [27] V. A. Filatov, O. Y. Kulyak, and E. I. Kalenikova, "Chemical Composition and Antimicrobial Potential of a Plant-Based Substance for the Treatment of Seborrheic Dermatitis," *Pharmaceuticals*, vol. 16, no. 3, 2023, doi: 10.3390/ph16030328.
- [28] B. Poojar *et al.*, "Methodology Used in the Study," *Asian J. Pharm. Clin. Res.*, vol. 7, no. 10, pp. 1–5, 2017, doi: 10.4103/jpbs.JPBS.
- [29] M. S. Bhavani, S. M. Jan, K. S. Rani, and M. Sreirekha, "Formulation, Evaluation and Comparison of the Herbal Shampoo with Commercial Shampoos," *Int. J. Pharm. Sci. Rev. Res.*, vol. 78, no. 1, pp. 41–45, 2023, doi: 10.47583/ijpsrr.2023.v78i01.007.
- [30] B. T. AlQuadeib, E. K. D. Eltahir, R. A. Banafa, and L. A. Al-Hadhairi, "Pharmaceutical evaluation of different shampoo brands in local Saudi market," *Saudi Pharm. J.*, vol. 26, no. 1, pp. 98–106, 2018, doi: 10.1016/j.jsps.2017.10.006.
- [31] P. A. Cornwell, "A review of shampoo surfactant technology: consumer benefits, raw materials and recent developments," *Int. J. Cosmet. Sci.*, vol. 40, no. 1, pp. 16–30, 2018, doi: 10.1111/ics.12439.
- [32] L. Khani Bisht, B. Jacob, and V. Chandy, "Evaluation Studies on Various Reputed Brands of Shampoo," *Asian J. Appl. Sci. Technol.*, vol. 1, no. 6, pp. 23–25, 2017, [Online]. Available: www.ajast.net