

RESEARCH ARTICLE

Comparative Investigation of Hair Shampoos Formulated Using Different Herbal Extracts

Mugdha Banduke¹, Akash Gaikwad¹, Harshada Chattar², Mohini Kuchekar³,
Bhushan Pimple^{3*}, Nitin Deshmukh⁴, Harshal Tare⁵

¹Department of Pharmacy, Progressive Education Society's Modern College of Pharmacy, Nigdi, Affiliated to Savitribai Phule Pune University, Pune, Maharashtra, India

²Department of Quality Assurance, Progressive Education Society's Modern College of Pharmacy, Nigdi, Affiliated to Savitribai Phule Pune University, Pune, Maharashtra, India

³Department of Pharmacognosy, Progressive Education Society's Modern College of Pharmacy, Nigdi, Affiliated to Savitribai Phule Pune University, Pune, Maharashtra, India

⁴Department of Science and Technology, Savitribai Phule Pune University, Pune, Maharashtra, India.

⁵Department of Pharmacognosy, Sharadchandra Pawar College of Pharmacy, Junnar, Affiliated to Savitribai Phule Pune University, Pune, Maharashtra, India.

Received: 06th October, 2022; Revised: 15th November, 2022; Accepted: 30th November, 2022; Available Online: 25th December, 2022

ABSTRACT

Cosmetics have fascinated the human race for ages. Cosmetics have been found to benefit in several ways such as enhancing appearance, protection, cleansing etc. If fortified with the benefit of herbal ingredients, these personal care products have proven to be a boon for many. The current study involves the formulation of seven shampoos using different herbal extracts and their comparative investigation for physicochemical and performance characteristics. Various herbal extracts using components such as coffee, fenugreek, green tea, bringaraj, onion seeds, orange oil, and lemon oil were developed and compared against the marketed standard. The effect of various extracts on the parameters such as surface tension, foam test and foam stability test, viscosity, cleansing test, sag test, dirt dispersion, wetting time and pH was successfully tested. All the formulations were found to be beneficial in eliminating oil, dirt, and dandruff, encouraging smooth, silky hair appearance, fortifying and darkening hair without altering or harming hair tresses. Our findings suggest the incorporation of fenugreek, lemon and orange peels to increase the cleansing ability. However, the inclusion of onion seeds and green tea has been found to be beneficial in the generation and stability of the foam.

Keywords: Bhringraj, Coffee, Cosmetics, Fenugreek, Onion, Herbal Shampoo.

International Journal of Pharmaceutical Quality Assurance (2022); DOI: 10.25258/ijpqa.13.4.04

How to cite this article: Banduke M, Gaikwad A, Chattar H, Kuchekar M, Pimple B, Deshmukh N, Tare H. Comparative Investigation of Hair Shampoos Formulated Using Different Herbal Extracts. International Journal of Pharmaceutical Quality Assurance. 2022;13(4):363-368.

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

Several cosmetics have been developed and tested for the fascination of mankind to be attractive and presentable. Hair and scalp remain the most exposed part of the human body to dirt, UV light, pollution, etc. Moreover, hair cleansing is more challenging than other body parts. Therefore, hair fall, itchy scalp, greying, alopecia and dandruff are common worldwide problems. Shampoos are formulated that offer attractiveness besides cleansing the hair and scalp. It also leaves the hair feeling manageable, shiny and smooth. However, there are some special shampoos that contain unique components with odd capabilities, such as medicated, anti-dandruff,

conditioning, baby care and premium conditioning shampoos etc.¹⁻³ There are many different types of shampoos available in the market like powder, liquid, cream, jelly, aerosol, keratin, volumizing and specialized shampoo. The powder shampoo is prepared with the addition of water at time of application. Liquid shampoos are made by means of detergent of low cloud point. The cream shampoo is also named as lotion shampoo, a modified form of a transparent liquid cream shampoo. The jelly shampoo is clear and thick in consistency, prepared by integrating gelling agents. The aerosol shampoo is also named as foam-type shampoo because when the valve is pressed, shampoo comes out of the container as foam. Keratin

*Author for Correspondence: pimplebhushan@yahoo.co.in

shampoos contain keratin oil as it is helpful to make hairs smooth and shiny. Volumizing shampoos give hair a bouncier and a more full-bodied appearance. The specialized shampoo is marketed especially to customers with dandruff, gluten or wheat allergies, color-treated hair, newborns, or young children.⁴

Many shampoos are made with a variety of components as medications. The negative effects of these medications include hair loss, dryness of hairs and greying of hair. From time immemorial humans have tried several natural products and articles for beautification. In recent decades, a trend of herbal products has lured consumers and hence is the base of research projects for many industries across the globe. Cost-effectiveness, nontoxicity and ease of availability of herbal ingredients endorse their employment in cosmetics.⁵ Traditional systems of medicine offer numerous options of natural ingredients to be added in hair formulations as natural plant extracts that have positive effects on skin and hair because they contain vitamins, amino acids, sugars, glycosides, phytohormones, bioflavonoids, fruit acids and essential oils.

The current study focuses upon the development of various herbal shampoos and their comparative evaluations. Components such as coffee, fenugreek, green tea, bringaraj, onion seeds, orange oil, and lemon oil were selected for study to prepare herbal shampoo formulations.⁶⁻¹³

MATERIAL AND METHOD

The crude drugs such as coffee seeds (*Coffea arabica* Linn), fenugreek seeds (*Trigonella foenum-graecum*), green tea leaves (*Thea sinensis* Linn), onion seeds (*Alium cepa* Linn), orange peel (*Citrus aurantium* Linn), bringaraj leaves (*Eclipta prostata* L), lemon peel (*Citrus limon*) were purchased from local market of Pune, India. Carbomer, triethylamine, ethanol and glycerol were purchased from local suppliers.

Preparation of Extracts

Accurately weighed 0.5 g each of coffee seeds, fenugreek seeds, green tea leaves, onion seeds, orange peel, lemon peel and bringaraj leaves were separately extracted using 5 mL ethanol (99.9% v/v) by cold maceration method. The drugs were placed in contact with the solvent for 24 hours and then filtered and evaporated to dryness.

Optimization for Formula for Gel Shampoo

After several trials, Carbomer solution (0.5% w/v) in water produced desired gel consistency along with triethylamine. Total 8 shampoos were formulated viz. control (without any active ingredient), coffee seeds (*Coffea arabica* Linn), fenugreek seeds (*Trigonella foenum-graecum*), green tea leaves (*Thea sinensis* Linn), onion seeds (*Alium cepa* Linn), orange peel (*Citrus aurantium* Linn), bringaraj leaves (*Eclipta prostata* Linn), lemon peel (*Citrus limon*). All the extracts 2.5 mL were dissolved in water to make 90 mL solution and gel was produced by adding 0.5 g carbomer and pH was adjusted to 8 by triethylamine benzalkonium chloride was added later.

Surface Tension

The density of 10% shampoo solution was calculated using a pycnometer at room temperature. The solution was later filled

into the stalagmometer using a rubber bulb. These viscous samples were then filled and sonicated as the sonication accelerates capillary action. The surface tension of samples was calculated as per the formula $\{\gamma_2 = (\rho_2 n_1 / \rho_1 n_2) \times \gamma_1\}$, Where, γ_1 and γ_2 are surface tension, n_1 and n_2 are no of drops and ρ_1 ρ_2 are density of water and sample respectively.^{14,1}

Foam Test and Foam Stability Test

A 10% solution of shampoo was taken in a test tube, 1 drop oil and 0.25 mg soil was added to simulate the clinical condition. Each test tube oscillated 20 times and the foam height was measured in cm at 0th, 5th, 10th, 15th and 20th minutes. The same process was carried out to assess the foam stability and the foam height was also measured.^{15,16}

Viscosity

A small sample adapter spindle was used to measure the viscosity of shampoos was determined at room temperature using Brookfield Viscometer. Shampoo was poured in a container in a quantity which was enough to submerge the spindle into it in a way that the spindle should not touch the edges of the container. The viscosity of shampoos at different rpm were recorded.¹⁵

Cleansing Test

The hair braids were made of a weight range between 0.5–1 gm. Weights of these braids were recorded and 0.5 mL of coconut oil was applied to each braid and weighed again to determine the amount of oil. Further, each braid was washed separately using 10% v/v shampoo solution, rinsed thoroughly under running water and dried with the aid of a hair dryer. Cleansing ability was determined by the differences between the weights of braids before and after washing. Moreover, the braids were also assessed for qualitative parameters such as luster, aroma, volume, split-ends, branching, and microscopy by an observer unaware about the study.⁴

Sag Test

Approximately 1 gm of shampoo was kept on a sieve of mesh no. 16, then the water was poured through a jet by a burette nozzle. The amount of water required to wash out all the shampoo and foam produced was recorded for all formulations.

Dirt Dispersion

A 10 mL (10% v/v) all shampoo solution was taken in the test tube and indiana ink was added in each tube. The tubes were oscillated longitudinally to produce foam. The migration of ink in the foam was recorded for each tube.¹⁷

Wetting Time

A 20 mL (10% v/v) all-shampoo solution was taken in a beaker and a filter paper disc (1-inch diameter) was placed on the liquid. The time required for the disc (in seconds) to settle at the bottom was recorded as wetting time.¹⁸

pH

The pH measurement is a very significant parameter and assists in decreasing discomfort due to the topical application of shampoo. pH of a (10% v/v) shampoo solution was recorded for all formulations using the digital pH meter.¹⁸

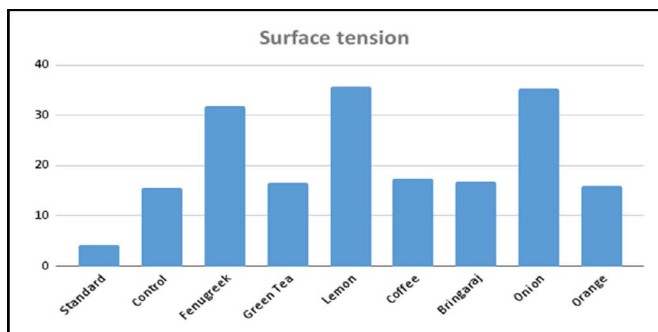


Figure 1: Surface tension study of herbal shampoo formulations

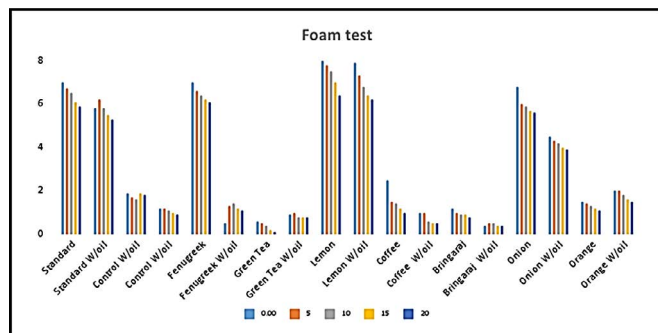


Figure 2: Foam study of herbal shampoo formulations

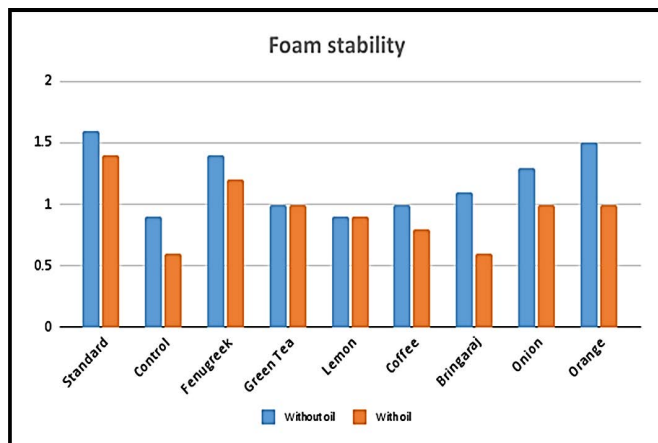


Figure 3: Evaluation study of foam stability of formulations

RESULTS

Surface Tension

The surface tension of various shampoo formulations was studied and compared with standard marketed formulations. It was observed that the fenugreek (35.67 dynes/cm), lemon peel (35.7 dynes/cm) and onion seed (35.29 dynes/cm) shampoos showed an increase in surface tension (Figure 1).

Foam Test and Foam Stability Test

The foam test was performed to evaluate shampoo formulations' foaming ability compared with standard marketed formulations. It was calculated by measuring foam height of all shampoo formulations. Maximum foam was produced in shampoo with

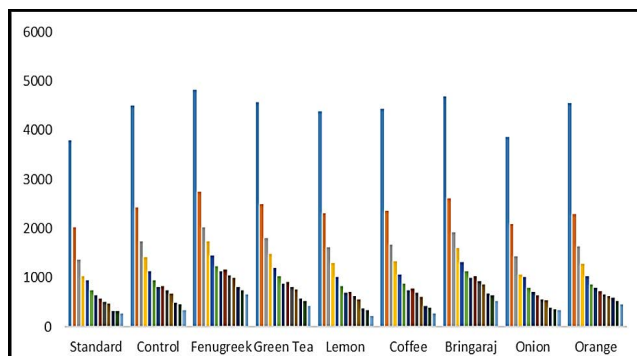


Figure 4: Rheological evaluation of herbal shampoo formulations by measuring viscosity at different rpm.

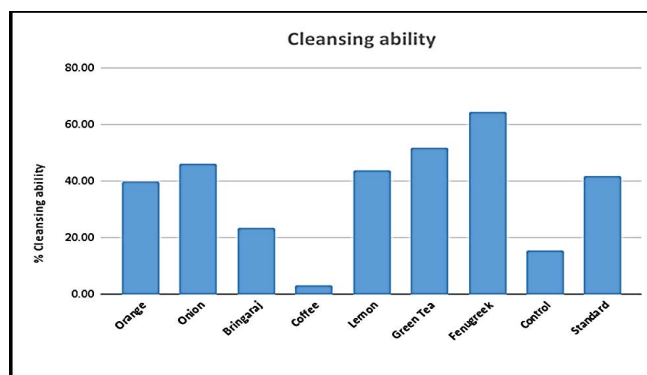


Figure 5 A: Comparative analysis of the cleansing ability of the herbal shampoo formulations.

lemon peel followed by fenugreek seeds, standard and onion seeds (Figure 2). Foam stability test (Modified Ross-Miles Test) is a stability study performed to assess the comparative stability of foam generated by all shampoo formulations. It was observed that the stability of foam generated by shampoos prepared from fenugreek, orange peels and onion seeds was comparable with the standard (Figure 3).

Viscosity

It is a crucial testing parameter for liquid and semisolid preparations to figure out the nature of flow is viscosity. Additionally, it significantly affects the preparations' packaging system compatibility. The viscosity of all the shampoo formulations was found to be almost similar to the concentration. In addition, it also exhibited a fall upon increasing the rpm of the spindle (Figure 4).

Cleansing Test

This test highlights the comparative evaluation of the cleansing power of all shampoo formulations. It was observed that the shampoo containing fenugreek, green tea, lemon peel, onion seeds and orange peel exhibited marked cleansing ability compared to the standard (Figure 5 A, B and C).

Sag Test

The water required to remove shampoo and its froth was found to be least in shampoo formulated using onion seeds and green tea (Figure 6).

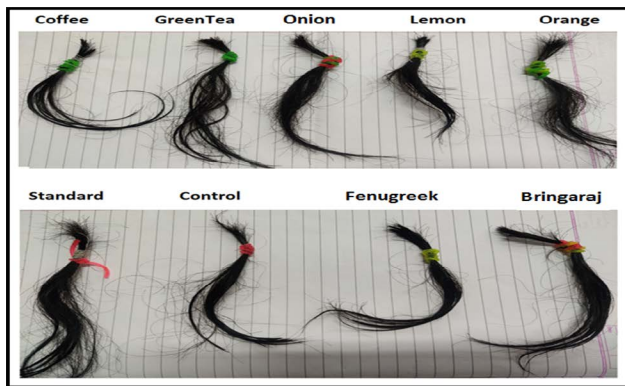


Figure 5 B: Comparative analysis of cleansing ability of the herbal shampoo formulations

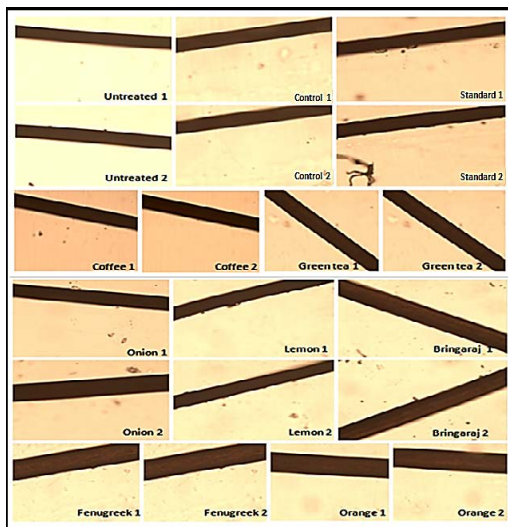


Figure 5 C: Microscopic analysis of cleansing ability of the herbal shampoo formulations

Dirt Dispersion

A low-quality shampoo concentrates the dirt in the foam because it will be challenging to rinse off and the dirt will reappear in the hair. Dirt dispersion test revealed that the formulated shampoo using all the natural ingredients, including standard, was effective in dispersion of dirt (Figure 7).

Wetting Time

The disc wetting time in seconds was found to be maximum for bringaraj and coffee seeds. All other formulations, including the control exhibited closeness in the wetting time(Figure 8).

pH

In order to assess a shampoo’s acidity and alkalinity, it is critical to know its pH. It increases and strengthens hair’s attributes, reduces eye irritants, and preserves the scalp’s ecological balance. The pH of all the formulations was found to be in range and around 7–8 (Figure 9).

DISCUSSION

Cosmetics products are gaining enormous prominence in recent decades. Shampoos, face powders, lipsticks and nail lacquers are the frontrunners among their counterparts.

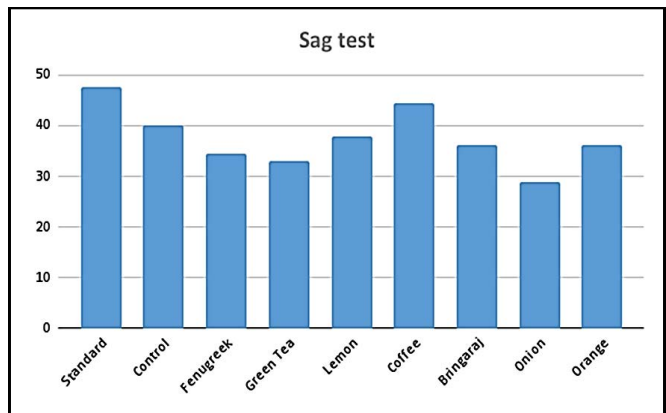


Figure 6: Comparative analysis of the herbal shampoo formulations for sag test.

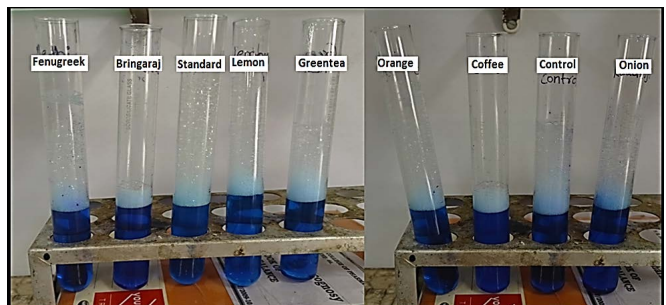


Figure 7: Dirt dispersion study test on herbal shampoo formulations

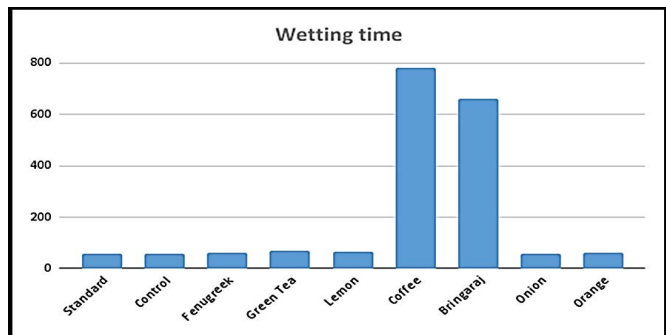


Figure 8: Comparative analysis of disc wetting time of herbal shampoo formulations.

Synthetic surfactants, plasticizers and colorants are proven to be carcinogenic and allergic, which sometimes damage the hair and are toxic in multiple ways.^{19,20} Shampoos are typically used to eliminate oily residues from previously used hair care products, including oils, lotions, sprays, dust, sweat, scales, and other environmental pollutants from the scalp.²¹ Depending on the formulation content, a vehicle is used to exert five major effects on the skin, including cleansing, adornment, hydration, care and protection.²² The employment of herbal ingredients in cosmetics is an emerging trend to exterminate toxicity and to alleviate consumer acceptability.²³ Formulation of several shampoos by incorporating natural ingredients was the basic objective of the study. The surface tension of the shampoos formulated using fenugreek, lemon peels and onion seeds were found to be on the higher side compared to the standard, this could be due to the surfactant properties

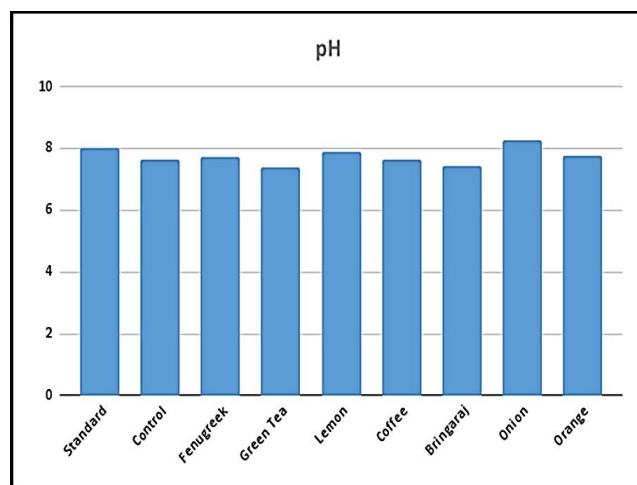


Figure 9: Analysis of pH of herbal shampoo formulations.

of trigonelline, hesperidin etc, present in these drugs. The surfactant property forms the basis for the removal of oil and associated dirt from the scalp. This is also evident from the increased cleansing ability produced by this shampoo. Foam test is the measure to determine the foaming ability. Foam is the prerequisite for selection of shampoo by the consumer. Although it does not play a significant role in cleansing ability, it satisfies the consumer psychologically. Stability in the foam was observed for shampoos formulated using fenugreek, orange peels and onion seeds. The surface tension plays a key role in maintaining the froth. Moreover, it was observed that shampoos that exhibited higher surface tension could generate copious amounts of froth.

The addition of herbal ingredients did not significantly alter the viscosity. This indicates the compatibility of all the herbal drugs with the excipients employed for the development of viscosity (carbomer and triethylamine). Sag test is performed to assess the rinsing ability of shampoo from the scalp in the presence of dense hair and also specifies the amount of water required to wash off the shampoo and its generated froth from the hair and scalp. This test is significant for areas with a scarcity of water and suggests any changes to be made in the formula. It is evident from the sag test that the onion seed and green tea-based shampoo required least amount of water for rinsing, hence the incorporation of these ingredients is highly recommended for shampoos that are specifically designed for marketing in drought-affected zones.

The dirt dispersion test implies the shampoo's solubility of dirt or oil. If the dirt or shampoo remains entrapped within the generated foam, even after several washings, the dirt resettles on the scalp. Thus, it is expected that the dirt remains soluble in the shampoo solution for ease of its removal. Wettability is an important parameter for the shampoo to adhere to the hair or scalp impregnated with oil or sebum. The wettability was found to be around one minute for each shampoo except for bringaraj and coffee seeds. The pH of shampoo depends basically upon the foaming agent used, since all the shampoos have similar basic formulas, pH was observed to be constant for all. An ideal shampoo should have a pH of 5.8 to 8.^{24,25}

CONCLUSION

Our findings are concurrent with earlier reports suggesting incorporating fenugreek, lemon and orange peels to increase the cleansing ability. However, the inclusion of onion seeds and green tea has been found to be beneficial in the generation and stability of foam. Further research in this arena with the inclusion of similar such drugs, needs to be stressed upon for developing shampoos with high efficiency. Thus, we conclude that the involvement of herbal extracts proves beneficial in elevating shampoos' desired performance.

ACKNOWLEDGMENT

We would like to acknowledge the Management of Progressive Education Society's Modern College of Pharmacy, Nigdi, Pune and Principal Dr. P. D. Chaudhari for their support in this research work.

CONFLICT OF INTEREST

We, the authors consciously declare that we do not have any conflict of interest to disclose.

REFERENCES

1. Al-Quadeib BT, Eltahir EKD, Banafa RA, Al-Hadhairi LA. Pharmaceutical evaluation of different shampoo brands -in local Saudi market. *Saudi Pharmaceutical Journal*. 2018;26:98-106.
2. Yateem H, Hanania M, Mosleh N. Formulation and evaluation of herbal shampoo containing olive leaves extract. *International Journal of Development Research*. 2018;8(10):23173-23176.
3. Reddy VS, Prasanthi S, Gopinath C, Rao KM. Shampoos: An Overview. *International Journal of Advances in Pharmaceutical Research*. 2015;6(11):384-387.
4. Sravanthi K, Kavitha N, Sowmya K, Naazneen S, Vaishnavi U, Anil CH. A Review on Formulation and Evaluation of Herbal Anti-Dandruff Shampoo. *International Journal of Pharmaceutical Research and Applications*. 2021;6(3):1300-1311.
5. Gubitosa J, Rizzi V, Fini P, Cosma P. Hair Care Cosmetics: From Traditional Shampoo to Solid Clay and Herbal Shampoo, A Review. *Cosmetics*. 2019;6(13):1-16.
6. Otberg N, Teichmann A, Rasuljev U, Sinkgraven R, Sterry W, Lademann J. Follicular Penetration of Topically Applied Caffeine via a Shampoo Formulation. *Skin Pharmacol Physiol*. 2007;20:195-198.
7. Kim S, Kim SN, Jeong G, Hong MJ, Lee Y, Shin SH, Park H, Jung YC, Kim EJ, Park BC, Kim HJ. Efficacy of Caffeine in Promoting Hair Growth by Enhancing Intracellular Activity of Hair Follicles. *Korean Journal of Cosmetic Science*. 2019;1(1):11-18.
8. Lodha G. Formulation and Evaluation of Polyherbal Shampoo to Promote Hair Growth and Provide Antidandruff Action. *Journal of Drug Delivery and Therapeutics*. 2019;9(4-A):296-300.
9. Suryawanshi NC, Vijayendraswamy SM, Nagoba SN, Wanje VV. Formulation and Evaluation of Herbal Hair Gel Containing Fenugreek Seed Extract for Nourishment and Hair Growth. *International Journal of Scientific Research in Science and Technology*. 2019;6(4):92-103.
10. Gharat, MV, Dalavi RV, Dound AA, Chikane AR, Walunj A, Kajal AA. Research Article on Formulation and Evaluation of Herbal Shampoo. *International Journal of Advanced Research in Science, Communication and Technology*. 2022;2(5):217-222.
11. Golhani D, Pandey V, Shukla A, Shukla R. Formulation and comparative evaluation of herbal shampoo with marketed

- products. *Mintage journal of Pharmaceutical and Medical Sciences*, 2015;4(3):4-7.
12. Zhang Q, Huang LL, Wei WC, Yang KK, Yu XZ. Development of citrus peel ethanolic extract shampoo. *Materials Science and Engineering*. 2019;479:1-7.
 13. Maurya P, Maury S, Yadav P, Yadav M, Maurya S, Jaysawal S. A review article on: Herbal shampoo. *Journal of Emerging Technologies and Innovative Research*. 2021;8(5):g366-g375.
 14. Newton A, Ihoeghiana A, Akwaraa E. Formulation, Evaluation and Comparison of Herbal Shampoo with Marketed Synthetic Shampoo. *Journal of Science and Technology Research*, 2021;3(4):342-348.
 15. Chavan VM, Tiwari KJ, Suryavanshi KA, Bhor AS. Formulation and Evaluation of Herbal Shampoo. *American Journal of Pharm Tech Research*. 2019;9(05):88-96.
 16. Aghel N, Moghimipour E, Dana AR. Formulation of a Herbal Shampoo using Total Saponins of *Acanthophyllum squarrosum*. *Iranian Journal of Pharmaceutical Research*. 2007;6(3):167-172.
 17. Gaikwad P, Kamini D, Mulay V, Borade MD. Formulation and Evaluation of Herbal Shampoo. *International Journal of Science and Research*. 2020;9(3):29-31.
 18. Badi KA, Khan SA. Formulation, evaluation and comparison of the herbal shampoo with the commercial shampoos. *Beni-Suef University Journal of Basic and Applied Science*. 2014;3:301-305.
 19. Dhyani A, Singh N, Kumar V. Formulation and evaluation of herbal shampoo containing extract of *Grewia optiva*. *International Journal of Engineering and Advanced Technology*. 2019;8(6S4):21-26.
 20. Sirsat SV, Rathi NM, Thakare SP, Sapkal MS, Chavare AG. Formulation and Characterization of Herbal Shampoo: A Review Article. *International Journal of Novel Research and Development*. 2022;7(4):848-853.
 21. Dhayanithi S, Enjamamul H, Pallavi N, Kavitha PN, Saraswathi A. Formulation and evaluation of herbal shampoo. *National Journal of Pharmaceutical Sciences*. 2021;1(2):88-93.
 22. Thakkar K, Patel D, Meshram DB, Patel M. Evaluation of standards of some selected shampoo preparation. *World Journal of Pharmacy and Pharmaceutical Sciences*. 2013;2(5):3622-3630.
 23. Sandeep DS, Nayak P, Nashiha A, Alfisha NK, Nanda NAR, Kumar A. Developing Anti-Dandruff Shampoo Formulations using different Indian Plant Herbs- An Eco-friendly Hair-care Cosmetic. *Journal of Xi'an Shiyou University. Natural Science Edition*. 2021;17(9):684-693.
 24. Arora R, Singh RK, Meenakshi B. Formulation and evaluation of herbal shampoo by extract of some plants. *The Pharmaceutical and Chemical Journal*. 2019;6(4):74-80.
 25. Sharma RM, Shah K, Patel J. Evaluation of Prepared Herbal Shampoo Formulations and to Compare Formulated Shampoo with Marketed Shampoos. *International Journal of Pharmacy and Pharmaceutical Sciences*. 2011;3(4):402-405.