

FORMULATION & EVALUATION OF HERBAL SHAMPOO

¹Ms. Sharddha A. Meshram, ²Dr. Surendra Pardhi

¹Research Scholar, Institute of Pharmaceutical Science & Research, Balaghat (MP)

²Professor, Scholar, Institute of Pharmaceutical Science & Research, Balaghat (MP)

ABSTRACT

Aim-The study aimed to formulate a pure herbal shampoo and to evaluate its physicochemical properties with the marketed synthetic and herbal shampoos.

Objective: The herbal shampoo was formulated by using *Acacia concinna*, *Sapindus mukorossi*, *Phyllanthus emblica*, *Ziziphus spina-christi* and *Citrus aurantifolia* in different proportions to a 10% aqueous gelatin solution.

Material & method: Extraction process were used to collect extraction of herbal drugs. To preserve the shampoo methyl paraben was added and pH was adjusted with citric acid.

Evaluation: Several tests such as pH, visual inspection, wetting time, % of solid contents, foam volume and stability, surface tension, , dirt dispersion, detergency etc, were performed to determine the physicochemical properties of formulated shampoos. The formulated herbal shampoo was also evaluated for conditioning performance by administering a blind test to 20 volunteers.

Result: The formulated herbal shampoo was found clear and appealing. It showed good cleansing and detergency, low surface tension, small bubble size and good foam stability after 5 min. The score of the conditioning performance of the tress washed with herbal shampoo was found to be 3.0 out of 4

Conclusion: The results indicated the formulated shampoo is having excellent conditioning performance, at equivalence with commercially available shampoo. However, to increase its quality and safety, though, more study and development are needed.

KEYWORDS: Shampoo:Herbal, Methyl paraben,,Physicochemical properties, stability

INTRODUCTION

Hair is one of the vital parts of the body derived from ectoderm of the skin and is protective appendages on the body and considered accessory structure of the integument along with sebaceous glands, sweat glands and nails. They are also known as epidermal derivatives as they originate from the epidermis during embryological development. Hair is an important part of the overall appeal of the human body. The primary function of shampoo is aimed at cleanse the hair necessitated due to accumulated sebum, dust, scalp debris, etc. Various shampoo formulations are associated with hair quality, hair care habits, and specific problems such as the treatment of oily hairs, dandruff, and for androgenic alopecia. Shampoos are liquid, creamy, or gel-like preparations. shampoo go well beyond simply cleansing the scalp. In addition to cleaning, it makes the hair manageable, simple to comb, and convenient to use. When used, hair products clean both your scalp and hair when applied to the scalp. Shampoos made from herbs are incredibly good for hair. same to ordinary shampoo, herbal shampoos are made from natural ingredients and intended to clean the hair and scalp. Since there are no surfactants used, these shampoos are stable, have less negative side effects, and are safer than synthetic shampoo.

Hair has a hair shaft and a hair root. The shaft is the visible part of the hair that sticks out of the skin. The hair root is in the skin and extends down to the deeper layers of the skin. It is surrounded by the hair follicle (a sheath of skin and connective tissue), which is also connected to a sebaceous gland. Each hair follicle is attached to a tiny muscle (arrector pili) that can make the hair stand up. Many nerves end at the hair follicle too. These nerves sense hair movement and are sensitive to even the slightest draft (Trimbak SD, 2024).

Hair Follicle: The hair follicle is where your hair begins to grow and is held in place. It's a stocking-like structure that starts in the epidermis, your skin's top layer. It extends to the dermis, your second layer of skin. At the bottom of the follicle, a piece of tissue called the papilla contains tiny blood vessels (capillaries). These nourish the hair root to keep it growing. The follicle also contains the germinal matrix, where cells produce new hairs. The sebaceous gland produces sebum, or oil, which is the body's natural conditioner. More sebum is produced during puberty, which is why acne is common during the teen years. Sebum decreases with age, causing the skin to become dry. The arrector pili muscle, a tiny bundle of muscle fiber, is attached to the outer sheath. When the muscle contracts, it causes the hair to stand up, otherwise known as goosebumps. Hair begins its journey of growth from a root in the bottom of the hair follicle. This root consists of cells and keratin, a protein which is essential for healthy hair growth. Blood from the blood vessels in the scalp nourish the root, which creates more cells and encourages the hair to grow. As the hair is pushed up through the skin as it grows, it passes an oil gland, along the way (Trimbak SD, 2024).

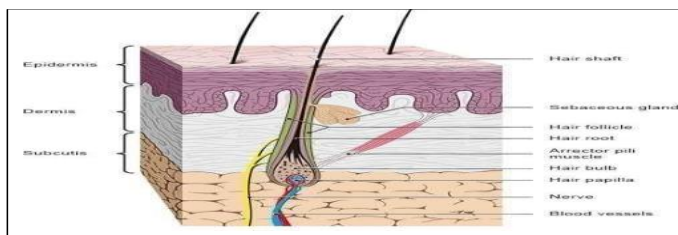


Figure1: Structure of Hair & Skin Hair Growth Cycle and Its Mechanism

The hair growth undergoes a tiresome cycle where the anagen phase followed by the catagen and the telogen phase [7]. In the anagen phase, the hair is actively growing while in the catagen phase it is characterized by the degeneration and resorption of the lower region of the hair follicle. The resting phase, where the hair is inactive, is called telogen phase after this phase the growth of the hair follicle resumes in the scalp, a hair growth cycle has three main phases: Anagen, catagen, and telogen. The anagen phase is the growth cycle typically lasts 3- 5 years. On a healthy scalp, there are approximately 1,000,000 hair and 90% of the follicles are continually in the anagen phase of hair growth. The catagen stage follows the end of the growth period when a follicle begins to become dormant. The telogen stage is a dormant or resting period that lasts 3-4 months. When the dormant phase ends, an old hair falls out. A hair follicle then returns to the anagen stage, and a new hair begins to grow. An average rate of hair growth is about half an inch per month depending on hair follicles and age of an individual. On average, 50-60 scalp hairs are lost daily in a normal hair growth cycle and new hairs begin to grow from these follicles. Hair loss begins when less new hair begins the re- growth stage (Pundkar AS, 2020).

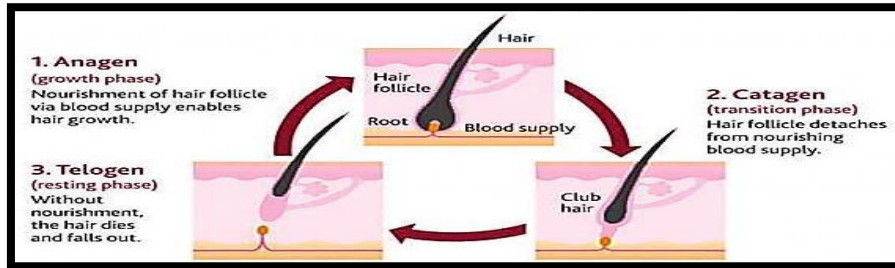


Figure2: Hair Growth Cycle

Hair problems & its solution:

Dandruff: Characterized by flaky, itchy scalp. Causes include fungal infections, sensitivity to hair products, and hormonal imbalances. Treatments include antifungal shampoos, medicated creams, and lifestyle changes.

Premature Greying: Caused by genetics, stress, and hormonal changes. Treatments include Ayurvedic remedies, hair dyes, and supplements.

Thinning: Characterized by gradual loss of hair density. Causes include genetics, hormonal imbalances, and aging. Treatments include hair growth supplements, scalp massages, and low-level laser therapy.

Dryness: Caused by environmental factors, harsh hair products, and hormonal imbalances. Treatments include moisturizing shampoos, hair masks, and coconut oil treatments.

Split Ends: Characterized by damaged hair cuticles. Causes include excessive heat styling, chemical processing, and dryness. Treatments include deep conditioning, hair masks, and trimming damaged ends.

Gray Hair: Caused by melanocyte damage, genetics, and hormonal changes. Treatments include hair dyes, Ayurvedic remedies, and supplements.

Hair Loss (Male/Female Pattern Baldness): Caused by genetics, hormonal imbalances, and aging. Treatments include medications, hair transplants, and low-level laser therapy.



Figure3: Common Hair and Scalp Problems

Alopecia: Alopecia is a condition characterized by hair loss, which can occur on the scalp, face, or other areas of the body. There are several types of alopecia, including:

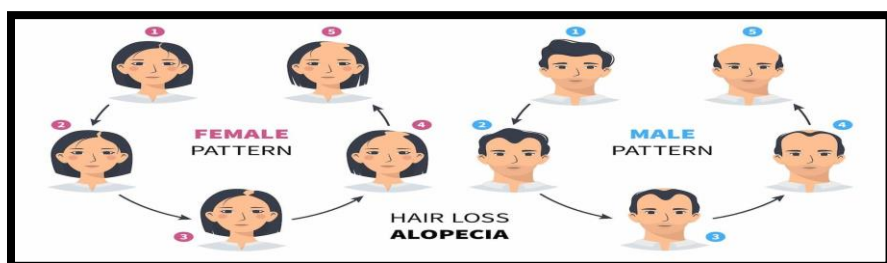
Alopecia Areata: An autoimmune disease that causes hair loss in small, round patches on the scalp, face, or body. It affects both children and adults, with a peak incidence in young adults. The exact cause is unknown, but genetic predisposition, stress, and hormonal imbalances may contribute to its development.

Androgenetic Alopecia: A common condition that causes hair thinning and loss, particularly on the scalp. It is caused by the conversion of testosterone to dihydro testosterone (DHT), leading to miniaturization of hair follicles.

Telogen Effluvium: A condition characterized by excessive shedding of hair, often triggered by physical or emotional stress, hormonal changes, or certain medications.

Alopecia Mucinosa: A rare condition that causes hair loss and the formation of mucinous nodules on the scalp or skin (Gupta K, 2024).

Alopecia areata is an autoimmune disease characterized by hair loss on body especially on scalp without any clinical inflammatory signs. Its prevalence in general population was estimated at 0.1-0.2% with a lifetime risk of 1.7%. Male was reported to be more affected with the disease in comparison to children and women, but it cause more emotional problems in woman and children due to cosmetic concern. Its main treatment in contemporary science is Corticosteroids which is having harmful side effects and not advisable for long term use. So, world is expecting some remedies from Alternative medical sciences. Ayurveda offers different effective treatment modalities for the management of different autoimmune diseases like psoriasis, eczema, etc. Alopecia areata can be correlated with Indralupta disease described in Ayurveda. In Ayurveda, both shodhana (Internal and external cleansing procedures) and shaman treatment (Disease specific internal medications) are prescribed for Indralupta. Here a case of female patient suffering from Alopecia areata was successfully treated with



Ayurvedic Shamana therapy along with nidanaparivarjana (Shingadiya R, 2017).

Figure4: Hair Loss (Alopecia)

Loss of hair or alopecia is a universal problem that has been estimated to affect between 0.2 and 2% of the world's population. Various synthetic formulations available for treatment of alopecia exhibit severe side effects and also do not cure the condition permanently while natural products are getting more popular mainly due to their fewer side effects. It is therefore necessary to discover natural remedies of plant origin having hair growth promoting potential to replace the synthetic one for the treatment of alopecia (Shingadiya R, 2017).

People in the tropical countries have effectively used coconut oil to promote hair growth and development as a traditional hair grooming practice. Virgin coconut oil is the purest form of coconut oil which retains most of its functional components. The aim of present study involves development of herbal hair oil from virgin coconut oil extracts of a mix of nine herbs which is beneficial as a hair tonic. The various herbs used in the formulation are amla, hibiscus, curryleaf, Aloe vera, henna, bhringraj, tulsi, small onion and neelaamari in varying concentration. Mixtures of these herbs are extracted in a definite proportion in virgin coconut oil and lavender oil is added for fragrance. The formula is finalized in such a way that the combination of ingredients provides essential nutrients such as protein, antioxidant vitamins and minerals which complement the normal function and nourishment of hair. The poly herbal hair oil developed was analyzed for organoleptic properties and various physical and biological properties. Parameters such as moisture content, pH, specific gravity, viscosity, acid value, saponification value etc., were evaluated and irritation test and sensitivity test were conducted and recorded. It

was observed that all the parameters were within the permissible limits. Herbal hair oil formulation showed the best result in hair growth having cooling effect with no side effects (Satheeshan KN, 2020).

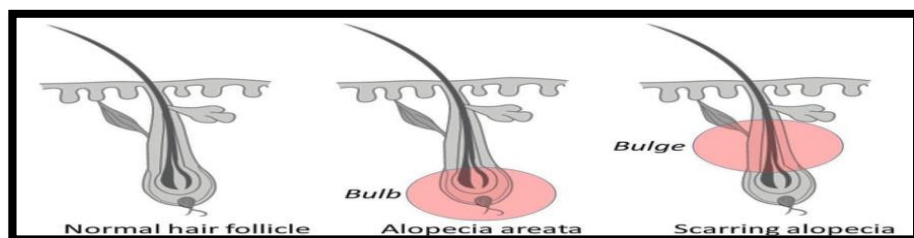


Figure5 Types of Alopecia

Hair plays a vital role in the personality of human and for their care we use lots of cosmetic products. Herbal formulations always have activity and comparatively lesser or no side effects with synthetic. This study aimed at reviewing the importance of poly herbal hair oil for the treatment of common hair problems such as baldness, alopecia, hair fall, gray hair, dryness and most common dandruff. The various herbal ingredients are used in the formulation. All ingredients provide essential nutrients such as vitamin, antioxidant, protein, terpenoids, and many essential oils to maintain normal function of sebaceous glands. The formulated oil was evaluated for its organoleptic properties, acid value, saponification value, viscosity, pH etc. All the parameters were found to be good and within the standards. This also helps to gain stability over scalp psoriasis and the damage caused by it on the scalp. Ingredients such as: Fenugreek, Flaxseeds, Bringraj, Hibiscus flower Almond oil, Aloe Vera seeds are used in scalp psoriasis. The main ingredient of this oil is fenugreek seeds. This hair oil reduces dandruff, promotes hair growth, reduces hair fall, naturally dyes and gives shine to our hair (Trimbak SD, 2024).

Plant profile:

Plant Name	Family	Chemical Constituents	Plant Picture
Acacia concinna (shikaka)	Fabaceae	α -amino acids , alkaloids, flavonoids, tannins, saponins, and phenolic compounds	
Sapindus mukorossi (Ritha)	Sapindaceae	saponins, triterpenoids, fatty acids, flavonoids, and phenols, oleic and linoleic acid	
Phyllanthus emblic (amla)	Phyllanthaceae	Vitamins Nicotinamide, Nicotinic acid, Choline, and Vitamin C, palmitic, and myristic	
Ziziphus spina-christi (ber)	Rhamnaceae	Quercetin, Betulinic acid	
Citrus aurantifolia (lemon)	Rutaceae	d-limonene, Citral: Apigenin, Palmitic acid:	

MATERIALS AND METHODS

This study was designed to formulate a herbal shampoo and to evaluate.

Sample collection: All plant materials were obtained from Nagpur, (M.H.) and were identified and authenticated by a botanist of Govt. J.S.T. College, Balaghat.

Preparation of plant extracts: 100 g of Ziziphus spina-christi leaves were washed under running water to remove foreign substances, homogenized and boiled in hot water for 4 h. The aqueous extract was filtered and concentrated to obtain semi solid mass (yield: 11% w/w). Aqueous extracts of Sheekakai and Amla were also prepared by the similar method (yield: 8.3% w/w and 8% w/w respectively). However, Reetha pericarps were extracted by cold maceration method using 70% ethyl alcohol to obtain 11.2 g of solvent free semi solid mass (yield-11.2% w/w).

Formulation of herbal shampoo: The plant extracts were mixed in different proportions to obtain a shampoo whose formula is shown in Table 1. Herbal extracts were added to 10% gelatin solution and were mixed by shaking for 20 min. Lemon juice (1 mL) and Methyl paraben were also added with stirring. Finally the pH of the solution was adjusted by adding sufficient quantity of 1% citric acid solution. Few drops of rose essential oil were also added to impart aroma to the prepared shampoo and the final volume was made to 100 mL with gelatin solution.

Table 1. Composition of herbal shampoo.

Material	Quantity
Reetha extract	2.5 g
Amla extract	2.5 g
Sheekakai extract	2.5 g
Sidr extract	2 g
Lemon juice	1 mL
Methyl paraben	1 mL of 0.05% solution
Gelatin solution	q.s
Citric acid	q.s
Essential oil	0.1 mL

Evaluation of formulated and commercial shampoo: To evaluate the quality of prepared formulations, several quality control tests including visual assessment, physicochemical controls conditioning performance tests were performed (Ashok and Rakesh, 2010).

- **Physical appearance/visual inspection:** The formulation prepared was evaluated for the clarity, color, odor and foam producing ability (Aghel et al., 2007).

- **Determination of pH:** The pH of 10% v/v shampoo solution in distilled water was measured by using pH meter (Mi 151, Martini instruments) at room temperature (Tarun et al., 2014).
- **Determination of % of solid contents:** 4 grams of shampoo were placed in a previously clean, dry and weighed evaporating dish. The dish and shampoo was weighed again to confirm the exact weight of the shampoo. The liquid portion of the shampoo was evaporated by placing the evaporating dish on the hot plate. The weight and thus % of the solid contents of shampoo left after complete drying was calculated.
- **Dirt dispersion test:** Two drops of shampoo were added to 10 mL of distilled water taken in a large test tube. To this solution, one drop of India ink was added and the test tube was stoppered and shaken ten times. The amount of ink in the foam was indicated by the rubric such as None, Light, Moderate or Heavy (Ali and Kadhim, 2011).
- **Surface tension measurement:** The surface tension of 10% w/v shampoo in distilled water was measured using stalagmometer at room temperature (Gaud and Gupta, 2001).
- **Test to evaluate foaming ability and foam stability:** Foaming ability was determined by using cylinder shake method. Briefly, 50 mL of the 1% commercial or formulated shampoo solution was placed into a 250 mL graduated cylinder; it was covered with one hand and shaken 10 times. The total volume of the foam content after 1 min of shaking was recorded. Foam stability was evaluated by recording the foam volume after 1 min and 4 min of shake test (Klein, 2004).
- **Wetting time test:** A canvas paper was cut into 1-inch diameter discs having an average weight of 0.44 g. The smooth surface of disc was placed on the surface of 1% v/v shampoo solution and the stopwatch started. The time required for the disc to begin to sink was noted down as the wetting time (Manikar and Jolly, 2000).
- **Evaluation of conditioning performance:** A hair tress of an Asian woman was obtained from a local salon. It was cut into four swatches of the tresses with approximately the length of 10 cm and the weight of 5 g. A swatch without washing served as the control. Other three tresses were washed with the commercial and formulated shampoos in an identical manner. For each cycle, each tress was shaken with the mixture of 10 g of a sample and 15 g of water in a conical flask for 2 min and then rinsed with 50 mL water. Afterward, each tress was left for air drying at room temperature. The tresses were washed for maximum ten cycles. The conditioning performance of the shampoos i.e. smoothness and softness, was evaluated by a blind touch test, administered to twenty randomly selected student volunteers (Boonme et al., 2011). All the students were blind folded and asked to touch and rate the four tresses for conditioning performance from score 1 to 4 (1 = poor; 2 = satisfactory; 3 = good; 4 = excellent).

Statistical analysis: Data were analyzed using SPSS v.19. All tests were performed in triplicate and data are expressed as Mean $\pm$ standard deviation. ANOVA single factor was used for determining significance. P values <0.05 were considered as significant.

RESULTS AND DISCUSSION

A herbal shampoo was formulated by mixing aqueous/alcoholic extracts of Ziziphus, Soapnut, and Sheekakai in definite amount as shown in Table 1. These plant materials contain phytochemicals such as saponins. Saponins are natural surfactants possessing good detergency and foaming properties. P. emblica and Sidr extracts were added as conditioning agent. A good shampoo must have adequate viscosity to facilitate removal from the bottle but must not drip down from the hair during use. A variety of natural materials is available for use as viscosity builders. We used 10% gelatin solution for this purpose as it shows pseudoplastic behavior and forms clear solutions. Citric acid was added to adjust the pH to the desired level. Lemon juice (1 mL) was also added

as natural antioxidant, chelating agent and antidandruff agent to maintain the acidic pH of formulation. Shampoo was further preserved by the addition of little amount of methyl paraben. Final formula of the prepared shampoo is presented in Table 1.

- A shampoo like any other cosmetic preparation should have good appealing physical appearance. The formulated shampoos were evaluated for physical characteristics such as color, odor and transparency (Table 2). Our prepared shampoo was transparent, light green and had good odor. No significant difference was observed in terms of odor, transparency and foaming characteristics .

Table 2. Physicochemical evaluation of formulated and marketed shampoo.

Empty Cell	Formulated shampoo	p-value
Color	Light green	
Transparency	Clear	
Odor	Good	
pH (10% solution)	7.02 $\pm$ 0.09	0.0005*
% Solid contents	22.75	
Foam volume (mL)	115 $\pm$ 3	<0.001*
Foam type	Small, dense	
Surface tension (dynes/cm)	38.72 $\pm$ 1.77	0.004*
Wetting time (sec)	187 $\pm$ 4	<0.001*

Results are mean $\pm$ SD (n = 3); *significant difference $p < 0.05$) by Anova single factor.

- Most shampoos are formulated as either neutral or slightly alkaline to minimize the damage to hair. The pH of shampoo also helps in minimizing irritation to the eyes, enhances the qualities of hair and maintain the ecological balance of the scalp (Baran and Maibah, 1998). The pH of prepared shampoos was found 7.02 $\pm$ 0.09
- Good shampoos usually have 20%–30% solid content as it is easy to be applied and rinse out from the hair. If it doesn't have enough solid it will be too watery and wash away quickly, similarly too many solids will be hard to work into the hair or too hard to wash out. The percent solid contents of all the tested shampoo was found within the range of 22–25% and are expected to wash out easily (Table 2).
- Dirt dispersion is an important criterion for evaluation of cleansing action of shampoo. Shampoos that cause the ink to concentrate in the foam are considered of poor quality because ink or dirt that stays in foam is difficult to rinse away and gets re-deposited on the hair (Ali and Kadhim, 2011). Therefore, the dirt should stay in the water portion for achieving better cleansing action. All shampoo concentrated the ink in the water portion, ensuring their satisfactory cleaning ability and actual effectiveness.
- The term indicates the amount of surfactant present in shampoo to reduce the surface tension. Lesser the surface tension stronger is the cleaning ability of the shampoo. A shampoo is considered of good quality if it decreases the surface tension of pure water from 72.28 dyn/cm to about 40 dyn/cm (Ilton

et al., 2007). All the tested shampoo showed similar reduction in surface tension ranging from 31.68 to 38.72 dyn/cm. The reduction in surface tension is an indication of their good detergent action. The formulated shampoo reduced the surface tension to 38.72 dyn/cm. The commercial synthetic or semi-herbal shampoos may contain excessive detergents, which can strip the hair of up to 80% of the oil and thus damage the hair. Using a mild detergent in our shampoo, we have ensured that this does not happen.

- Foaming or lathering is very important to the consumer and therefore, it is considered as an important parameter in evaluation of shampoo. Formulated shampoo produced the foam volume above 100 mL (115, mL). The foams generated by formulated shampoo were small, compact, uniform, denser and stable. Tested shampoo had the same foam volume for 5 min showing that their foam has good stability. The higher foaming property of formulated shampoo may be due to the combination of soap nut, Sheekakai and Ziziphus (Sarath et al., 2013).
- The wetting ability of a surfactant is dependant on its concentration and is commonly used to test its efficacy. The canvas disc method is quick, efficient and reliable test to evaluate the wetting ability of a shampoo (Manikar and Jolly, 2000). The wetting time of three shampoo was found in the order 187 s for formulated shampoo respectively.
- Conditioning performance of three shampoos based on the mean scores of student referees is presented in Table 3. Majority of the students rated that the tress washed with dove provided the best conditioning performance and as expected the control tress (without washing) got the minimum score (1.1). The score of the conditioning performance of the tresses washed with formulated shampoo was found to 3.0 out of 4 The results clearly indicated that the formulated shampoo is having good conditioning performance level.

Table 3. The mean score of the student volunteers opinion on the conditioning performance of the tresses after treatment with shampoos (n = 20).

Score	Formulated shampoo	No washing
1	1	18
2	3	2
3	11	0
4	5	0
Average	3	1.1

Score 4 = excellent; score 3 = good; score 2 = fair and score 1 = poor.

CONCLUSION

The aim of this study was to formulate a completely herbal shampoo which is at parity with the synthetic shampoo available in the market. We formulated a herbal shampoo by using plant extracts which are commonly used traditionally used for their hair cleansing actions across india. All the ingredients used to formulate shampoo are safer than silicones and polyquaterniums synthetic conditioning agents and vis a vis can greatly reduce the hair or protein loss during combing. We have used Sheekakai, Amla, Ziziphus and other plant extracts to provide the conditioning effects. Several tests were performed to evaluate and compare the physicochemical

properties of both prepared. Our prepared shampoo showed good results for quality control tests but further research and development is required to improve it's over all quality.

REFERENCES

1. N. Aghel, B. Moghimipour, R.A. Dana, Formulation of a herbal shampoo using total saponins of *Acanthophyllum squarrosum*, Iran J Pharm Res, 6 (3) (2007), pp. 167-172,
2. H.S. Ali, R.B. Kadhim, Formulation and evaluation of herbal shampoo from *Ziziphus spina* leaves extract, IJRAP, 2 (6) (2011), pp. 1802-1806
3. K. Ashok, R.M. Rakesh, Evaluation of prepared shampoo formulations and to compare formulated shampoo with marketed shampoos, Int J Pharm Sci Rev Res, 3 (1) (2010), pp. 120-126
4. R. Baran, H.I. Maibah, Cosmetic dermatology in children, Text book of cosmetic dermatology (2nd ed.), CRC Press, London (1998), pp. 507-508
5. P. Boonme, N. Pakpayat, K. Yotmanee, S. Kunlawijitrungrsee, D. Maneenuan, Evaluation of shampoos containing silicone quaternary microemulsion, J App Pharm Sci, 1 (2011), pp. 59-63
6. Y.F. Chen, C.H. Yang, M.S. Chang, Y.P. Ciou, Huang Y.C. Foam Properties and detergent abilities of the saponins from *Camellia oleifera*, Int J Mol Sci, 11 (2010), pp. 4417-4425,
7. Firthouse, 2009, P.U. Firthouse, Effects of *Ocimum sanctum* and *Azadiracta indica* on the formulation of antidandruff herbal shampoo powder, Der Pharm Lett, 1 (2) (2009), pp. 68-76,
8. R.S. Gaud, G.D. Gupta, Practical physical pharmacy, (1st ed.), C.B.S. Publisher and Distributer, New Delhi (2001), pp. pp.81-105
9. P.S. Ilton, R. Deptuck, B. Bousfield, D. Verge, K. Antoni, L. MacRae, et al., Can J Neurosci, Nurs, 29 (1) (2007), pp. 14-19
10. M.K. Ishii, Objective and instrumental methods for evaluation of hair care product efficacy and substantiation of claims, Hair and hair care, Marcel Dekker, Inc, New York (1997), pp. 261-302
11. V.P. Kapoor, Herbal cosmetics for skin and hair care, Nat Product Radiance, 4 (4) (2005), pp. 306-314
12. Khushboo et al., 2010, P.S. Khushboo, V.M. Jadhav, V.J. Kadam, N.S. Sathe, *Psoralea corylifolia* Linn.—“Kushtanashini”, Pharmacognosy Rev, 4 (7) (2010), pp. 69-76
13. K. Klein, Evaluation of shampoo foam, Cosmet Toilet Mag, 119 (10) (2004), pp. 32-35
14. G.E. Mahran, K.W. Glombitza, Y.W. Mirhom, R. Hartmann, C.G. Michel, Novel saponins from *Ziziphus spina-christi* growing in Egypt, Planta Medica, 62 (20) (1996), pp. 163-165
15. A.R. Manikar, C.I. Jolly, Evaluation of commercial herbal shampoos, Int J Cosmet Sci, 22 (5) (2000), pp. 385-391
16. A.R. Manikar, C.I. Jolly, Formulation of natural shampoos, Int J Cosmet Sci, 23 (1) (2001), pp. 59-62
17. Pooja, N. Arun, K. Maninder, Shampoos based on synthetic ingredients vis-à-vis shampoos based on herbal ingredients: a Review, Int J Pharm Sci Rev Res, 7 (1) (2011), pp. 41-46
18. Potluri, S.S.K. Asma, N. Rallapally, S. Durrivel, G.A. Harish, Review on herbs used in Anti-dandruff shampoo and its evaluation parameters, Indo Am J Pharm Res, 3 (4) (2013), pp. 3266-3278
19. C. Sarath, K.V. Vipin, R.A. Ann, K.V. Lindumol, S. Arun, Development and evaluation of antidandruff shampoo based on natural sources, J Pharm Phytother, 1 (4) (2013), pp. 10-14
20. P.R. Shinde, A.U. Tatiya, S.J. Surana, Formulation development and evaluation of herbal antidandruff shampoo, Int J Res Cosmet Sci, 3 (2) (2013), pp. 25-33
21. K.P. Srivasuki, Nutritional and health care benefits of amla, J Pharmacogn, 3 (2) (2012), pp. 147-151
22. J. Tarun, J. Susan, V.J. Susan, S. Criton, Evaluation of pH of bathing soaps and shampoos for skin and hair care.
23. Indian J Dermatol, 59 (5) (2014), pp. 442-444