

Formulation and Evaluation of Hibiscus Herbal Shampoo And comparison of Formulated Shampoo with Commercially available Shampoo

Gayathri G A^{*1}, Denisha J R^{*2}, Lavanya J M^{*3}, Dr. Arun T S^{*4}, Dr. Prasobh G R^{*5}

1* Student, eighth semester B Pharm, Sree Krishna College of pharmacy and Research Centre, Parassala , Thiruvanthapuram ,Kerala ,India -695502

2* Student, eighth semester B Pharm, Sree Krishna College of pharmacy and Research Centre, Parassala, Thiruvanthapuram, Kerala, India-695502

3* Student, eighth semester B Pharm, Sree Krishna College of pharmacy and Research Centre, Parassala , Thiruvanthapuram ,Kerala ,India -695502

4* Associate Professor, Department of Pharmaceutics, Sree Krishna College of pharmacy and Research Centre, Parassala , Thiruvanthapuram ,Kerala ,India-695502

5* Principal, Sreekrishna college of pharmacy and research centre, parassala, thiruvanthapuram, kerala, india - 695502

Date of Submission: 15-01-2025

Date of Acceptance: 25-01-2025

ABSTRACT

This study focuses on the formulation, evaluation, and comparison of herbal shampoos incorporating Hibiscus rosa-sinensis and other natural ingredients. Herbal shampoos are gaining preference due to their minimal side effects, absence of harmful chemicals like sulfates, and their benefits for hair care. The formulation process included ingredients such as hibiscus powder, aloe vera gel, soap nut, gelatin, lemon juice, rose water, and methyl paraben. The study aimed to assess the shampoo's physicochemical properties, antimicrobial activity, and effectiveness compared to commercial shampoos. Evaluation parameters such as pH, viscosity, foam stability, surface tension, and dirt dispersion were measured. Results indicated that herbal shampoos provided conditioning, dandruff prevention, and improved hair texture while being safer and environmentally friendly alternatives to synthetic shampoos. This research highlights the potential of herbal shampoos as effective and sustainable hair care solutions.

Keywords: physicochemical properties, antimicrobial, conditioning, evaluation

I. INTRODUCTION

Cosmetics is a subset of health and beauty items which are used to treat the face and body as well as to enhance or alter a person's look. [1]"Articles intended to be rubbed, poured,

sprinkled, or sprayed on, introduced into, or otherwise applied to human body for cleansing, beautifying, promoting attractiveness, or altering the appearance without affecting structure or function" is how the food and drug cosmetic act define cosmetics. European subset of health and beauty goods known as cosmetics are used to either enhance or modify a person's look or to take care of the face and body. Cosmetics are defined as "articles intended to be rubbed, poured, sprinkled, or sprayed on, introduced into, or otherwise applied to human body" under the Food, Drug, and Cosmetic Act. [2]



Fig 1: Cosmetics

ANATOMY OF HAIR

Hair is regarded as an accessory structure along with sweat glands, sebaceous glands, and nails, of the integument and is one of the body's essential components. Adults often have the greatest amounts of hair in the axillae, around the external genitalia, in the brows, and across the scalp. Hairs on the head protect the scalp from harm and UV radiation, despite their limited ability to shield the scalp. It lessens scalp heat loss as well. The hair in the nose and external ear canal, as well as the brows and eyelashes, all provide protection from foreign objects.^[3]

Hair has a vital aesthetic function on our bodies. The hair on a person's head contributes to their overall attractiveness and beauty.

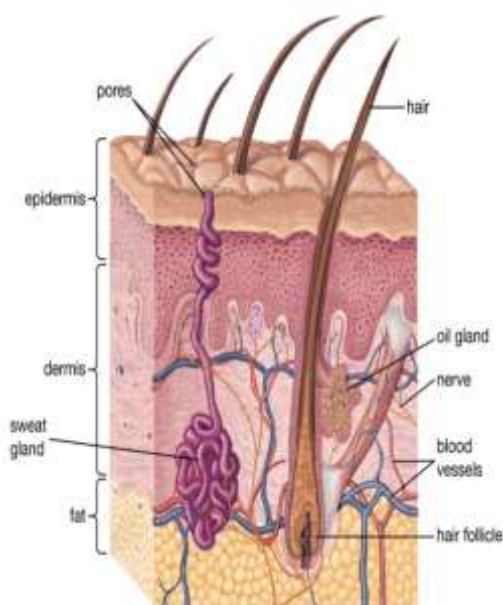


Fig 2: Hair structure

The frequency of columns of dead, keratinized epidermal cells held together by extracellular proteins make up hair. The part of the hair that is visible above the skin's surface is called the shaft. The section of hair that extends deep into the shaft and occasionally into the subcutaneous layer is called the root. The medulla, cortex, and cuticle of the hair are the three concentric layers of cells that make up the hair shaft and root. The inner medulla is made up of two or three rows of irregularly shaped cells, and it may not be present in thinner hair. The majority of the shaft is made up of elongated cells that make up the middle cortex. The outermost layer of hair, known as the cuticle, is made up of the outermost layer, consists of single

layer of thin, flat cells that are the most heavily keratinized. Surrounding the root of the hair is the hair follicle, which is made up of an external root sheath and internal root sheath, together referred to as an epithelial root sheath.

A hair normally grows at the rate of approximately 1 cm per month, but each hair grows in cycles, each cycle being constituted by^[4]–

- The growth phase (Anagen)
- The transition phase (Catagen)
- The resting phase (Telogen)



Fig 3: Hair growth cycle

SHAMPOOS

Shampoos are presumably applied to the skin like makeup. It is a hair care product that we use on a daily basis to clean our hair and scalp. Shampoos are a viscous solution of detergents with appropriate additions, preservatives, and active compounds that are most commonly used as beautifying agents.

Typically, it is rubbed into wet hair after being applied, and then the hair is cleaned by running water over it. Shampoo is used to loosen built-up debris from hair without drastically reducing sebum production. There are currently a lot of synthetic shampoos available on the market, both medicated and non-medicated. However, herbal shampoo has gained popularity because it comes from a natural source, is safer, improves customer demand, and has no negative side effects.

Synthetic surfactants are added to shampoos primarily for their washing and foaming qualities; nevertheless, prolonged use of these surfactants can cause severe side effects, including drying of the hair, irritation of the scalp and eyes,

and hair loss. We can use shampoos with natural herbal ingredients as an alternative to synthetic ones. It is quite challenging to formulate cosmetics with entirely natural ingredients, nevertheless.



Fig 4: Shampoo

Numerous medicinal plants that have been used for years to treat hair problems are included in shampoo formulations and have been used traditionally all over the world. These therapeutic plants can be utilized in extract, powdered, crude, or derivative form. It is challenging to create a synthetic shampoo that is safer and has a milder effect than one made entirely of natural ingredients. detergent with appropriate compounds for additional advantages including lubrication, medicine, and improved hair conditioning, among others. There are a lot of synthetic, herbal, medicated, and non-medicated shampoos on the market these days, but customers are becoming more and more interested in herbal shampoo because they think that since it comes from natural sources, it is safe and doesn't have any negative effects. Shampoo contains synthetic surfactants mainly for foaming and cleaning purposes; nevertheless, prolonged usage of these surfactants can cause hair loss, scalp discomfort, and eye irritation. Herbal shampoo recipes are thought to be an alternative to synthetic ones, but making cosmetics with just natural ingredients is challenging. Numerous medicinal herbs are said to have positive effects on hair, and they include^[5]:

BENIFITS OF HERBAL SHAMPOO-

1. It gives more Shine
2. Less Hair Loss
3. Stronger and More Fortified Hairs
4. All Natural, No Chemicals

5. It won't Irritate Skin or Scalp
6. Keep Healthy Natural Oils

FUNCTION OF HERBAL SHAMPOO-

1. Medication
2. Conditioning
3. Hair Growth
4. Maintenance of Hair Color

DESIRED PROPERTIES OF HERBAL SHAMPOO-

1. Ease of Application
2. Removal of More Debris
3. Easy Wet Combing
4. Fragrance
5. Low Level of irritation
6. Well Preserved
7. Good Stability

ADAVANTAGES OF HERBAL SHAMPOO-

1. Pure and Organic Ingredient
2. Free from Side Effects
3. No Surfactants e.g.: - SLS
4. No Synthetic Additives
5. No Animal Testing
6. Earth And Skin Friendly
7. No Petroleum based Ingredients

PLANT PROFILE

Hibiscus rosa-sinensis Linn.

Synonyms: Jaswand ,Shoe flower ,Jaswandi

Biological source: it consists of flowers of hibiscus rosa-sinensis or hibiscus sabdariffa

Family : Malvaceae

Chemical constituents: The main chemical constituents are taraxeryl acetate, beta-sitosterol, stigmasterol, cholesterol, lipids. flowers contain di glucoside, flavoids, vitamins and niacin.

Is a shrub, it is thought of native to Asia (India to Malaysia) or Tropical Africa. The plant is widely grown in tropics like Caribbean, Central America, India, Africa, Brazil, Australia, Hawaii, Florida and Philippines as a home garden crop. In Sudan, it is a major crop of export especially in western part where it occupies second place area wise after pearl millet followed by Sesamum^[6].

The plant is about 3.5cm tall and has a deep penetrating taproot. It has a smooth or nearly smooth, cylindrical, typically dark green to red stem. Leaves are alternate, 7.5-12.5cm long, green with reddish veins and long or short petioles, Leaves of young seedlings and upper leaves of older plants are simple, lower leaves are deeply 3 10 5 or even 7-lobed and the margins are toothed.

Flowers, born singly in the leaf axils are up to 12.5cm wide, yellow or buff with a rose or maroon eye and turn pink as they wither at the end of the day. The typically red calyx, consist of 5 large sepals with a collar (epicalyx) of 8 to 12 slim, pointed bract (or bracteole) around the base, the begins enlarge at the of the day, 3.2-5.7cm long and fully enclosed fruit. The fruit is a velvety capsule, 1.25-2cm long, which is green immature, 5 valve, with each valve containing 3 to 4 seeds. The capsule turns brown and splits open when mature and dry. Seeds are kidney shaped, light brown, 3 to 5mm long and covered with minute, stout and stellate hairs^[7].



Fig 5: Hibiscus

Uses

The versatile roselle plant, whose outer leaves (calyx), often referred to as natal sorrel is widely used to make jelly, jam, juice, wine, syrup, pudding, cake, ice cream, and flavouring.

It is a valued culinary product because of its distinctive flavour and beautiful red colour. An annual crop, roselle is utilized in pharmaceuticals, food, animal feed, nutraceuticals, and cosmeceuticals.

Hibiscus also provide hair growth, hair texture, hair colour, antidandruff properties, scalp health, shine to hair^[8].

AIM AND OBJECTIVE

AIM

To formulate, evaluate and compare the herbal shampoo in cooperated with of **hibiscus rosa-sinensis**

OBJECTIVE

- To develop a shampoo with other natural ingredients.
- To formulate shampoo free from harmful chemicals such as sulphates
- To ensure the effectiveness of the active ingredients.
- To compare the performance of herbal shampoo with commercial shampoos.

II. MATERIALS AND METHODS

MATERIALS

RAW MATERIALS AND EXCIPIENT PROFILE

All the materials used in the present study i.e., aloe vera gel, soap nut powder, gelatin, lemon juice, rose water, methyl paraben, distilled water, were purchased from local market. The details of materials used for the formulation of hibiscus herbal shampoo is mentioned below:

1. ALOE VERA GEL

Synonym: Acemannan

Biological source: Pulp collected by incision, from the bases of the leaves of various species of aloe barbadensis miller, Aloe ferox miller etc.

Family: Liliaceae

Chemical constituents: The most important constituents of aloes are the three isomers of aloins, barbaloin, beta barbaloin and isobarbaloin. Other constituents are amorphous aloin, resin, emodin and aloemodin.

Therapeutic uses: Aloe vera is widely used in hair care due to its hydrating, soothing and nourishing properties.it contains vitamins, minerals, amino acids, and enzymes that promote scalp health, reduce hair damage and improve hair texture^[9].



Fig 6: aloe vera

2.SOAP NUT

Synonyms: soapberry, washnut, ritha, arishtak

Biological source: The fruit of trees and shrubs of *Sapindus emarginatus*

Family: Sapindaceae

Chemical constituents: The important constituents of soap nut are saponins, sugars, fatty acids, tannins, flavonoids and calcium oxalate

Therapeutic use: soap nut is widely used in hair care due to its natural cleanser, antidandruff, promote hair growth or prevent hair thinning and reduces frizz.^[10]



Fig 7: Soap nut

3.GELATIN

Gelatin is a natural polymer which is made of hydrolytic degradation of protein from collagen and its distinctive structure of amino acids gives it several medical benefits. Chemically, gelatin is made up of 18 varieties of complex amino acids, ca. 57% of glycine, proline and hydroxyproline are the major compounds, while the remaining ca. 43% are other distinguished amino acids families such as glutamic acid, alanine, arginine and aspartic acid. Gelatin is composed of 25.2% oxygen, 6.8% hydrogen, 50.5% carbon, and 17% nitrogen. Gelatin can be used in hair care to strengthen hair, improve its texture, and make it shinier.^[11]



Fig 8: Gelatin

4.LEMON JUICE

Biological source: it is a small evergreen tree belonging to *Citrus limon*

Family: Rutaceae

Chemical constituents: citric acid, ascorbic acid, flavonoids, minerals and essential oil

Therapeutic Uses: Lemon fruit and juice have been used traditionally in various cultures for their medicinal properties. They are rich in vitamin C, flavonoids, and citric acid, which contribute to their antioxidant, antibacterial, and immune-boosting effects. Lemon extracts are valued in cosmetic formulations for their astringent, cleansing, and clarifying properties. In skincare and hair care products, lemon extracts are used to control excess oil production, reduce acne and blemishes, and brighten dull skin and hair. Lemon juice or extract is commonly added to shampoos, cleansers, and toners to purify the scalp, remove buildup, and impart a fresh, revitalizing scent.^[12]



Fig 9: Lemon juice

5. ROSE WATER

The rose plant is widely known plant in the ayurvedic system of medicine, and its benefits have been recognized for centuries. The rose plant belongs to the family Rosaceae and is known for its fragrant flowers, which are widely used in cosmetics, perfumes and medicines. It has natural conditioning properties that can help improve the texture and manageability of hair.^[13]



Fig 10: Rose water

6. METHYL PARABEN

Methylparaben is one of a homologous series of parabens, used singly or in combination to exert the intended antimicrobial effect. Pure methyl paraben is a colourless crystalline or white powder. Its antimicrobial activity, safety to use (i.e. relatively non-irritating, non-sensitizing, and of low toxicity), stability over the pH range, and solubility in water to produce the effective concentration in aqueous phase. Parabens are widely used in cosmetics as preservatives and are present in a large variety of products, including shampoo.^[14]



Fig 11: Methyl paraben

7. DISTILLED WATER

Distilled water is water that has been boiled into vapour and condensed back into liquid in a separate container. Impurities in the original water that do not boil below or near the boiling point of water remain in the original container. Thus, distilled water is a type of purified water. Purified water is water that is essentially free of microbes and chemicals. This is achieved by reverse osmosis (forcing the water through a membrane to get rid of chemicals, minerals and microbes).^[15]



Fig 12: Distilled water

ROLE OF INGREDIENTS

SL NO	INGREDIENTS	ROLE
01	Hibiscus	Conditioning scalp, hair growth and antidandruff activity
02	Aloe vera	Moisturizer
03	Soap nut	Natural surfactant
04	Gelatin	Improve hair strength
05	Lemon juice	Scalp cleansing and antidandruff activity
06	Rose water	Fragrance agent
07	Methyl paraben	Preservative

Table no.1 :Role of ingredients

COLLECTION AND AUTHENTICATION METHOD

The method used in this study is decoction. The shampoo was prepared by using the decoction from dried and powdered hibiscus and soap nut. The gelatin is dissolved in warm water and mixed with active ingredients. Later incorporate aloe vera gel, lemon juice, and rose water along with preservative.

- Weigh all the ingredients according to the formula.
- Decoction of hibiscus powder and soap nut was prepared in 100 ml of water in a beaker,

simmer for 20 minutes until the water reduces to half.

- Strain the decoction by using a muslin cloth.
- Dissolve gelatin in 50 ml of warm water.
- Mix the active ingredient with dissolved gelatin.
- Incorporate aloe vera gel, lemon juice and rose water.
- Dissolve methyl paraben to the formulation.
- The product is allowed to cool and transfer to a tightly closed container. ^[16]

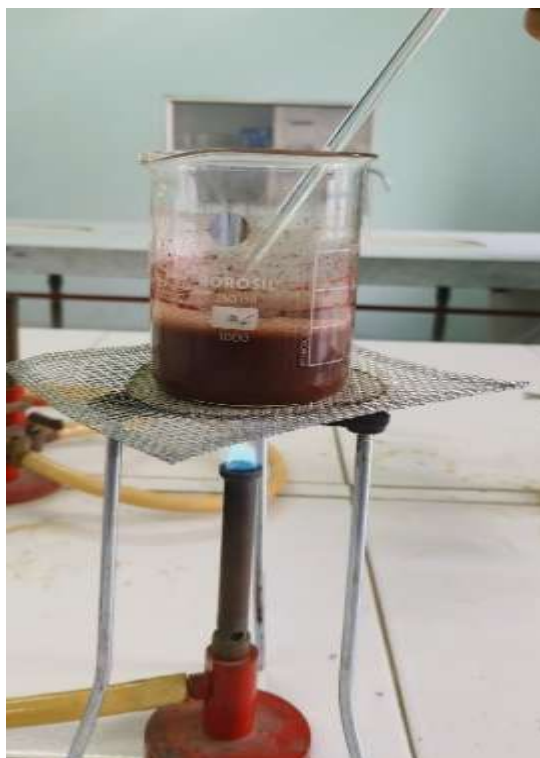


Fig no:13 Decoction method



Fig no: 14 Gelatin solution

DIRECTIONS TO USE HERBAL SHAMPOO

1. Wet Your Hair:

Start by thoroughly wetting your hair with water.

2. Apply Shampoo:

Take an adequate amount of shampoo in your palms and gently apply it to your scalp and hair.

3. Massage Gently:

Massage the scalp using your fingertips in circular motions for about 2–3 minutes. This helps to stimulate blood circulation and ensures the shampoo reaches all parts of your scalp and hair.

4. Leave for Absorption:

Leave the shampoo on your scalp and hair for 2–3 minutes to allow the herbal ingredients to work effectively.

5. Rinse Thoroughly:

Rinse with water to remove all shampoo. Ensure no residue is left in your hair.

6. Repeat if Needed:

If your hair is very oily or dirty, you may repeat the process.

FORMULATION

INGREDIENTS	FORMULATION	
	F1	F2
Hibiscus powder	5g	7g
Aloe vera gel	10ml	10ml
Soap nut	8g	8g
Gelatin	2g	2g
Lemon juice	3ml	3ml
Rose water	8ml	8ml
Methyl paraben	0.25ml	0.25ml
Distilled water	q.s	q.s

Table no .2:Formulation



Fig no:15 Formulation and Marketed Products

EVALUATION PARAMETERS

1. PHYSICAL APPEARANCE

The formulation prepared were evaluated in terms of their clarity, with brown colour and good in odour with foam producing ability and fluidity.^[17,18]

2. DETERMINATION OF PH

The pH of 10% shampoo solution in distilled water was determined at room temperature 25 degree Celsius with help of pH meter and litmus paper.^[19,20]

3. DETERMINATION OF PERCENTAGE SOLID CONTENTS

A clean dry China dish was weighed and added with four grams of shampoo. the dish with shampoo was weighed. The exact weight of the shampoo was calculated. The China dish with shampoo was placed on the hot plate until the liquid portion was evaporated. The weight after drying was calculated.^[21,22]

4. RHEOLOGICAL EVALUATION

The viscosity of the shampoo was calculated by using Oswald's viscometer. When a liquid flows through the capillary tube, the time required for the liquid to pass between two marks (A and B) is determined. The time of flow of a liquid tests is compared with the time required for the reference sample of known viscosity (normally water is used).^(23,24)

5. DIRT DISPERSION

In the large test tube have 10 ml of distilled water with adding 2 drops of shampoo.in this Indian ink and test tube covered with stopper and shake it 10 times. The amount of ink in the foam was measured with as None, Light, Moderate or heavy.^[25,26]

6. SURFACE TENSION MEASUREMENT

Dilute the shampoo using distilled water to fix 10% as concentration.measurements were carried out using stalagmometer.Dip the flattened end of stalagmometer into beaker containing sample of developed shampoo and suck it until the level reaches the mark.fix that in the stand and allow the sample to run slowly from the mark.count the number of drops formed when level of fluid reaches from A to B. Repeat the experiment with

distilled water. The data was calculated using following equation,

$$R_2 = \frac{(W_3 - W_1) N_1 \times R_1}{(W_2 - W_1) N_2}$$

W1 is weight of empty beaker. W2 is weight of beaker with distilled water W3 is Weight of beaker with shampoo solution. N1 is no. of drops of distilled water N2 is no. of drops of shampoo solution. R1 is surface tension of distilled water at room temperature. And R2 is surface tension of shampoo solution

7.FOAMING ABILITY AND FOAM STABILITY:

Cylinder shake method with slight modification was used for determining foaming ability. 50ml of the 1% shampoo solution was put into a 250 ml graduated measuring cylinder and covered with hand. Measuring cylinder was shaken for 1 minute. The total volume of the foam contents after 1 minute shaking was recorded. The procedure was continued for 5 minutes.

8.IN-VITRO ANTI-DANDRUFF ACTIVITY:

In this method the agar is melted, cooled at 45 °C, inoculate with candida albicans and then pour in the sterile petri plate. In this method when the agar plate has been solidified then holes about 9mm in diameter in the medium with sterile cork borer, Then the antimicrobial agent is placed in the hole and in another hole placed marketed formulation acts as standard, the diameter of zone of inhibition were measured after incubation at 30-35°C for 24 hours. The diameter of zone of inhibition gives an indication of the relative activity of different antimicrobial substance against tested microorganism.

III. RESULT AND DISCUSSION

1.PHYSICAL APPERANCE

SL.NO	EVALUATION PARAMETER	F1	F2	M1	M2
1.	Colour	Brown	Brown	Pale Yellow	Light brown
2.	Odour	Pleasant	Pleasant	Pleasant	Pleasant
3.	Transparency	Smooth	Smooth	Clear	Thick

Table no.3:Physical appearance

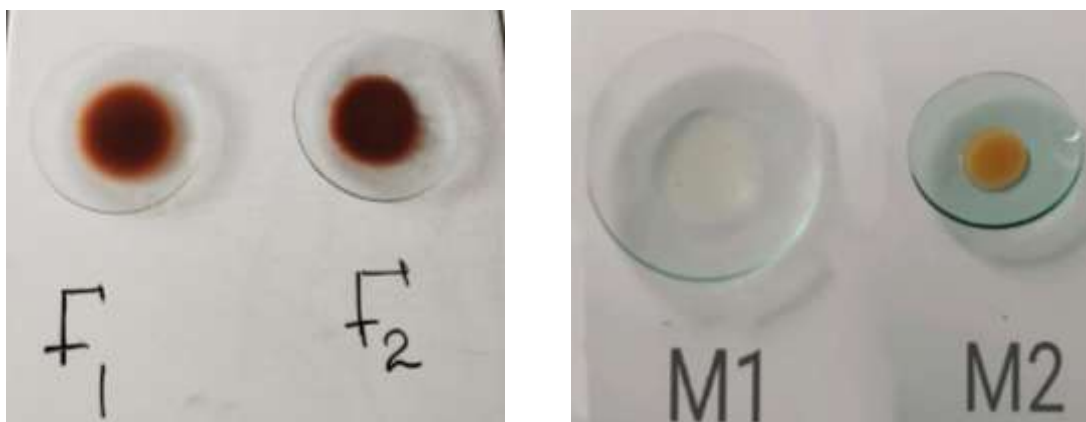


Fig no: 16 Physical appearance of(F) and (M)

2.DETERMINATION OF pH

SL.NO	FORMULATION	PH
1.	F1	5.12
2.	F2	5.40
3.	M1	8.15
4.	M2	6.78

Table no.4:Determination of pH

3.PERCENT OF SOLID CONTENT

SL.NO	FORMULATION	PERCENT SOLID CONTENT (%)
1.	F1	28.55
2.	F2	29.5
3.	M1	23.5
4.	M2	22.5

Table no.5 :percent solid content



Fig no : 17 Determination of solid content of (F) and (M)

4.RHEOLOGICAL EVALUATION

SL.NO	FORMULATION	VISCOSITY
1.	F1	1.48
2.	F2	1.60
3.	M1	2.04
4.	M2	2.54

Table no.6:Rheological evaluation



Fig no : 18 Rheological Evaluation

5.DIRT DISPERSION

SL.NO	FORMULATION	FOAM QUANTITY
1.	F1	NONE
2.	F2	LIGHT
3.	M1	MODERATE
4.	M2	MODERATE

Table no.7:Dirt dispersion



Fig no : 19 Dirt dispersion of (F) and (M)

6.SURFACE TENSION

SL.NO	FORMULATION	SURFACE TENSION (dynes/cm)
1.	F1	35.84
2.	F2	37.15
3.	M1	27.99
4.	M2	22.13

Table no.8:Surface tension



Fig no : 20 Determination of Surface tension

7.FOAMING ABILITY AND FOAM STABILITY

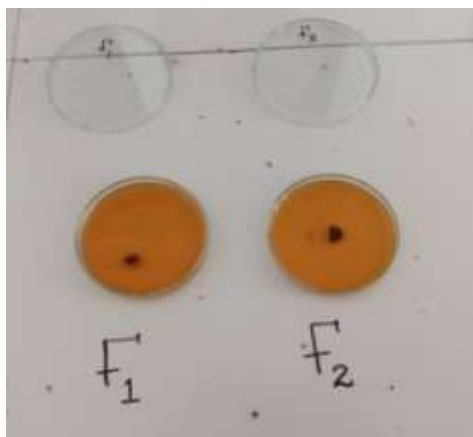
SL.NO	FORMULATION	FOAM VOLUME (ml)
1.	F1	60
2.	F2	58
3.	M1	100
4.	M2	120

Table no.9:Foaming ability and foam stability



Fig no : 21Foaming Ability (F) and (M)

8. INVITRO ANTIDANDRUFF ACTIVITY

FORMULATED PRODUCT	MARKETED PRODUCT
BEFORE	BEFORE
	
AFTER	AFTER
	



SL.NO	FORMULATION	ZONE OF INHIBITION(mm)
1	F1	10
2	F2	11
3	M1	9
4	M2	9

Table no 10 :Invitro antidandruff activity of formulation

From the above table it is evident that formulated Anti-dandruff shampoo has shown maximum inhibition, i.e. 10mm for F1 and 11mm for F2 ,whereas, marketed formulation possesses lower antifungal activity as compared with our formulation.

IV. CONCLUSION

The study successfully formulated and evaluated herbal shampoos using Hibiscus rosa-sinensis and other natural ingredients like aloe vera, soap nut, and lemon juice. The findings demonstrated that herbal shampoos are effective in cleansing, conditioning, promoting hair growth, and reducing dandruff, while avoiding the adverse effects associated with synthetic shampoos. The evaluation parameters, including pH, foam stability, surface tension, and dirt dispersion, confirmed the stability, safety, and performance of the herbal formulations also the result from the invitro antidandruff activity confirms that our formulated herbal shampoo exhibited maximum inhibition ,when compared with marketed formulation.

Compared to commercial shampoos, the herbal formulations exhibited comparable or superior results, highlighting their potential as safe, eco-friendly, and consumer-preferred alternatives in the hair care industry. This research underscores the viability of natural ingredients in developing sustainable cosmetic products that align with

consumer demand for organic and chemical-free solutions.

REFERENCE

- [1]. Parish LC, Crissey JT. Cosmetics: A historical review. Clinics in dermatology. 1988 Jul 1;6(3):1-4.
- [2]. Parhi R. The role of phytocompounds in cosmeceutical applications. In Medicinal Plants 2019 May 10 (pp. 139-160). CRC Press.
- [3]. B. M. Mithal and R.N.Saha written a handbook of cosmetics. Vallabh Prakashan 2009, 105
- [4]. Tortora GJ, Derrickson BH. Principles of anatomy and physiology. John Wiley & Sons; 2018 May 15.
- [5]. Dr. N J Paulbudhe, formulation and evaluation of herbal shampoo, 2020 ,1-3
- [6]. Gautam RD, Sorrel- A lesser-known source of medicinal soft drink and food in India, Nat Prod Rad, 2004, 3(5), 338-342.
- [7]. Leung AY and Foster S, Encyclopaedia of Common Natural Ingredients used in Food, Drugs and Cosmetics, 2nd ed, John Wiley and Sons, New York, 1996.
- [8]. Julia F, Roselle, in: Fruits of warm climates, edited by Morton J, Miami, 1987, 281-286(also available on <http://www.hort.purdue.edu/newcrop/morton/roselle.html>).

- [9]. Prithviraj Balasaheb Ugale et al., Formulation and Evaluation of Herbal shampoo using *Alor barbadensis miller*, 2023,540-542.
- [10]. V.N Meena Devi, The Multi facetious Uses of Soap nut tree, 2012,421-422.
- [11]. Z Pang et al, The study of Rheology texture and Micro structure of Gelatin gel 2014,2
- [12]. Vijayvargiya P A Review on *Limonia acidissima* L: Multipotential medicinal plant. *Int J Pharm Sci Rev Res* ,2014,191-195.
- [13]. Sharifi-Rad J et al, Traditional uses and Therapeutic Application, *Plants of the genus Rosa* ,2020,1505.
- [14]. M G Sony et al, Food and Chemical toxicology 2002,1335-1373.
- [15]. C Adamus Removal of antibiotics from surface and distilled water in conventional water treatment 2002,253.
- [16]. A.R. Mainkar and C. I. Jolly, Formulation of natural shampoo, *International Journal of Cosmetic science*, 2001,23:59-62.
- [17]. Jyothi Gahlawat, Formulation and Evaluation of Poly herbal Liquid shampoo, Vol 6 2019,149-154.
- [18]. Chandran S Chandran S, Vipin KV, Augusthy AR, Lindumol KV, Shirwaikar A. Development and evaluation of antidandruff shampoo based on natural sources. *J Pharm Phototherapeutics*. 2013; 1(4):10-4.
- [19]. Shinde PR, Tatiya AU, Surana SJ. Formulation Development and Evaluation of Herbal Antidandruff Shampoo. *International Journal of research in Cosmetic Science*. 2013; 3(2):25-33.
- [20]. 16. Chavan VM, Suryavanshi KJ, Bhor AS. Formulation and Evaluation of Herbal Shampoo. 2019;9(5):88-96.
- [21]. Jadhav SS, Jadhav KS, Dalvi YV. Formulation and evaluation of herbal liquid shampoo. *Res J Top Cosmetic Science*. 2018;9(2):44-48.
- [22]. Kumar A, Mali RR. Evaluation of prepared shampoo formulations and to compare formulated shampoo with marketed shampoos. *Evaluation*. 2010;3(1):0-25.
- [23]. Saraf S, Hargude SM, Kaur CD, Saraf S. Formulation and evaluation of herbal shampoo containing extract of *Allium sativum*. *Res J Top Cosmetic Science*. 2011;2(1):18.
- [24]. Priya DG, Kamini VM, Madhavee DB. Formulation and evaluation of herbal shampoo. 2018;9(3):29-31.
- [25]. Nikam NR, Patil PR, Jadhav RP, Vakhariya RR, Magdum CS. Formulation and evaluation of herbal shampoo: A comparative study. *Evaluation*. 2019; 1:6-25.
- [26]. Vijayalakshmi A, Sangeetha S, Ranjith N. Formulation and evaluation of herbal shampoo. *Asian J Pharm Clinical Research*. 2018;11(4):121-124.
- [27]. Bala R, Madaan R, Arora S. Green Synthesis and Characterization of silver nanoparticles using Kinnow mandarin peels extract and its application in Shampoo Formulation. *Res J Pharm Technol*. 2017;10(8):2461-2466.