IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

"FORMULATION AND EVALUATION OF HERBAL SHAMPOO AND COMPARITIVE STUDY WITH MARKETED FORMULATION"

Submitted in partial fulfillment of the requirements for the degree of Bachelor of Pharmacy by

KHAN AIMAN ABDUL WAHID AAMINA (Roll no: 20PH01)

MAHALDAR FATIMA SARTAJ AHMED FEHMIDA (Roll no: 20PH52)

MULANI ZAINAB MUNIR PARVEEN (Roll no: 20PH60)

SHAIKH BUSHRA MOHAMMED SUHAIL (Roll no: 20PH84)

KHAN SADIYA FATIMA IMRAN AHMED SHAMA AFROZ (Roll no: 21DPH06)

Supervisor

Dr.Madhuri Vilasrao Gaikwad

Department of PHARMACEUTICS,

School of Pharmacy

1. INTRODUCTION

1.1 HAIR

Hair or pili, are the outgrowths of the integument system known as the epidermis covering almost the entire body.[6] They are, however, devoid solely of the borders of associated with the hands, only the sides and plantar surfaces of both feet and lips and the neighborhood with the urogenital orifice.[6]
A hair is made up of dead and keratinized cells.[7]
Hair consist of the uppermost layer that is called shaft of the hair. A cylindrical section is created by the straightened hairshaft while an elliptical cross section is created by wavy hair shaft and a kidney shape is made by coiled hairshaft.[6]
The root of the hair is the portion of the hair which buries deep into the epidermis or subcutaneous layer.[6]

The shaft and the root both consist of three concentric layers:[6]

- Medulla
- Cortex
- Cuticle

Medulla is the apex of the shaft which consist of two to three rows of cells that look like polyhedrons and they host pigment granules and breathing chambers.[6] Cortex is situated peripherally to the medulla and apparently makes up the largest part of the limb. Cuticle is the outer part of the hair and made from single layer of thin and flat cells . They are majorly keratinized.[6]

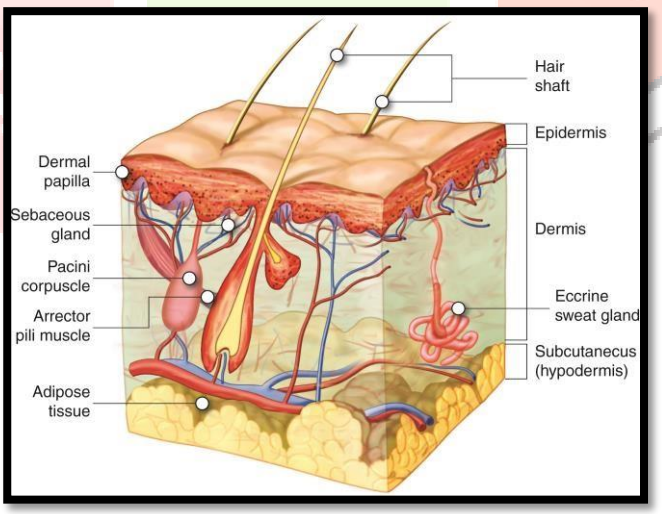


Figure 1 Hair anatomy [10]

Hair follicle is tunnel shaped structure in the epidermis of the skin where the hair starts growing.[9]
Hair follicle consists of three parts:

- Infundibulum
- Isthmus
- Inferior Segment

Infundibulum is the path from the surface opening of the hair follicle to the depth of the outlet of the sebum gland. The infundibulum is one of the components of the pilosebaceous canal system, which are used as conduits from the sebum discharge. Isthmus has its beginning from infundibulum up till the point where the arrector pili muscle inserts. The initial stage of hair growth appears to be the part where the bulb increases in size which is known as bulb. Papilla is a cavity in the bulb base, derived from the loose connective tissue on a vascular mesh.

Hair growth cycle :[8]

- Anagen phase(Hair growth)
- Catagen phase (Transition phase)
- Telogen phase (Resting phase)
- Exogen phase (Hair shedding)

In the anagen phase which is the first or foremost part of the hair growth cycle, hair begins to develop. At this time, the hair cells of the bulb undergo a rapid mitosis which leads to an active growth phase. Anagen phase counts for 2 to 7 years. The period of time that anagen lasts is responsible to the maximum hair length.[8]
Catagen phase is the transition phase that comes up after the anagen phase. This is the vital phase that lasts for 2 to 3 weeks of duration.
In the telogen phase, a period of renewal and rejuvenation of hair follicle occurs, preparing it for another hair growth cycle. This phase lasts upto 3 months.[8] Exogen phase is the last period of hair cycle. When the hair gets exogenous, they shed and go off to the root. Hair sheds about 50 to 100 hair everyday. After this phase, the follicle then revert to the anagen phase and the cycle starts again.[8]

1.1.2 FUNCTION OF THE HAIR:

One of the hair's main role is to protect the scalp from external elements such as sun, wind, cold, heat, pollution. Hair on the head perform various functions the first is protecting the scalp from ultraviolet light, cushioning the head, and insulating the skull. Hair supports evaporation and perspiration which helps in flow of outer water going away from the body. It also helps in human sensing function.[7]

1.2 SHAMPOO:

Shampoos are the cosmetic preparation which is meant for cleansing dirt, dust from hair[3]. It is used to impart luster shine to the hair. In ancient times, soap cake was used for washing hair. Nowadays various shampoo formulation are available.
Primary function of shampoo is to remove the excess sebum form the scalp and debris[4]. Shampoo must be safe to use and free from harsh chemicals as it reduces itchiness to the scalp and may also damage the hair[4]. Shampoo offer different color, transparency, pleasant effect, fragrance, good foam. Shampoo are available in various forms such as clear liquid shampoo, powder shampoo, dry shampoo, lotion shampoo, cream shampoo, jelly shampoo and so on.[1] Various chemical based shampoo are available in the market which are medicated and nonmedicated once [3]. But herbal shampoo due to its aesthetic properties are preferred by the consumers.
An alternative to synthetic shampoo is herbal shampoo which is free from harsh chemicals and contains natural ingredients. Side effects caused by synthetic shampoo are excess drying of hair, hairfall, scalp and eye irritation and so on. These side effects are not seen in herbal shampoo.[2]

A good shampoo must possess following characteristics:

- It should be non-toxic and non-irritant
- It should provide good cleaning effect
- It should have good foaming ability
- It should maintain pH between 4 to 6
- It should impart good fragrance to the hair
- Is should not cause damage to the hair

These property are present in herbal shampoo than the synthetic shampoo.[5]

1.3 HERBAL SHAMPOO

Herbal shampoos are the herbal hair care preparation which are meant to provide natural benefits to the scalp and hair. They promote the hair growth, prevents different hair problems such as hair fall, hair breakage, split ends, dandruff, irritation, scalp issues. [5] Herbal shampoos are increasing the demand worldwide because of the natural ingredients present in it which provides maximum benefits and minimum side effects.[5]

Herbs or the extract are used for the preparation of herbal shampoo. Different herbs that can be utilized for the formulation are aloevera, tulsi, shikakai, bhringraj, amla, triphala, sariva (anantmool), henna, neem, and many more.[1]

1.3.1 FUNCTION OF HERBAL SHAMPOO: [11]

1. Herbal shampoo provides moisturization to the hair and prevents drying of the scalp.
2. It makes the hair lustrous and smooth soft and manageable.
3. It stimulates the hair growth
4. It prevents the premature greying of the hair by acting as a natural colorant.
5. Some herbal shampoos provide a medicated action by treating dandruff, hairfall, split ends.

1.3.2 LIMITATIONS OF HERBAL SHAMPOO:[12]

The main constraints of the herbal shampoo are:

1. Natural ingredients could end up as a problem regarding product uniformity between batches and reproducibility of the preparation.
2. The stability of the herbal shampoo is not guarenteeed so one should add preservatives to ensure that microbes can’t grow on and that the product has long expiry date.
3. The efficacy of herbal shampoo can differ if the herbal ingredients used are of better quality and higher concentration.

On the other hand, the side effects of the herbal shampoos are negligible which stipulates their popularity.

2. REVIEW OF LITERATURE

2.1 HERBAL SHAMPOO SHOWING AN ANTI-MICROBIAL ACTIVITY.

Namita1, Nimisha 2013 describes in this articlethat herbal shampoo shows antimicrobial activity. The herbs such as bhringraj, amla, reetha, jatamansi, neem and aloe herbs contribute to the hair strengthening and hair growth without damaging the hair. It also treats the hair problems which is caused due to microbes. Bhringraj is highly effective for rejuvenating the hair, amla is often used as a hair tonic. Jatamansi exhibits antifungal activity.[13]

2.2 PREPARATION AND EVALUATION OF HERBAL SHAMPOO

Rimjhim Arora*, Rathore Kamal Singh, Bharakatiya Meenakshi 2019 gives an overview about the preparation and evauation of herbal shampoo. The herbal shampoo was prepared using polyherbals, caster oil, ethoxylated polyethylene glycol 400, glycerin, methylparaben, acacia, tragacanth, and essential oil. The shampoo was tested for viscosity, dirt dispersion, cleansing action, surface tension to check its suitability for use. Visual testing, pH testing, foam volume calculations and stability studies was performed as a part of quality control measures to evaluate the formulations done. The results showed that the herbal shampoo had the desirable properties like pseudo plastic behaviour, dirt dispersion, satisfactory cleansing action and the ability to decrease the surface tension of water to an optimum level.[14]

2.3 ROLE OF TRADITIONAL INDIAN HERBS FOR SHAMPOO FORMULATION AND ITS COMPARATIVE STUDY

Imran patel, Adnya talathi 2016 gave an overview of efficiency of Indian herbs used in shampoo. Herbal shampoo was prepared using aqueous extract of Aloevera, Acacia cancina(Shikakai) , Sapindus Mukorossi (Reetha) , and Phyllantus emblica as a replacement for synthetic surfactants. Phyllanthus emblica (Amla) formulation showed the highest cleaning ability, while Acacia cancina formulation exhibited the highest detergency ability. Other herbal extracts such as Neem , Aloevera, lemongrass have been used for treating the scalp issues. Sapindus Mukorossi exhibited anti microbial and hepatoprotective properties. Phyllanthus emblica demonstrated antioxidant ad anti-inflammatory properties. [15]

2.4 FORMULATION OF POLYHERBAL SHAMPOO TO STIMULATE THE HAIR GROWTH AND PROVIDES ANTIDANDRUFF ACTIVITY.

Gaurav Lodha 2019 provides the valuable insights on the use of bhringraj, shikakai, triphala, fenugreek, neem, etc. These are used to combat the dandruff and itchy scalp . They also promote the hair growth. These herbal ingredients contributes to the overall product effiency.[16]

2.5 TRIPHALA STIMULATING HAIR GROWTH AND IMPROVING OVERALL HAIR HEALTH.

Dr. Sandeep T S 2024 describes Aloepecia areta is a hair condition in which there is severe loss of hair which can cause baldness and other scalp and hair issues. The treatment for this is use of Triphala which strongly promtes hair growth, purifies the blood and also provides anti-microbial activity.
It also reduces hairfall trigerred by infection. Triphala is indicated for making the hair black and as a dyeing agent for coloring the hair. It is beneficial for the hair conditions caused by aggrevated kapha, vata, pitta.[79]

2.5 COMPARISON OF HERBAL SHAMPOO WITH THE COMMERCIAL SHAMPOOS

Khaloud Al Badi, Shah A. Khan 2014 provides main objective to study and evaluate wetting ability and conditioning performance of three shampoos : Dove, Herbal essences and formulated shampoo. The wetting time measured detergent concentration and the Dove showed least wetting time indicating higher detergent content. Also dove showed best conditioning property followed closely by the formulated shampoo. The herbal shampoo which was formulated to compete with the synthetic shampoo, uses plant extracts known for their traditional hair cleansing properties. The shampoo formulation contained plant extracts like Zizipus, Soapnut, Sheekakai, P emblica and Sidr as conditioning agents with viscosity and appearance considerations.[3]

2.6 NO SULFATES NO PARABENS AND THE NO POO METHOD

Abigail Cline, MD, PhD; Laura N. Uwakwe, MD; Amy J. McMichael, MD 2018 provides an overview on importance of sulfate and paraben free shampoo. Surfactants are meant for providing the cleansing action which reduce the surface tension between water and the dirt allowing the removal of environmental dirt from the hair and the scalp. Surfactancts that contains parabens and sulphates can damage the hair as well as the scalp and can lead to hair problems. Sulfates particularly sodium lauryl sulfate received a negative reputation with claims of scalp irritation , cataract formation, carcinogenicity, which lacks scientific support.So a great alternative is using mild surfactants and those surfactants that are free from sulfates and parabens that is no poo method. Sulfate free shampoos are rising the consumer demand worldwide.[80]

2.7 HERBAL SHAMPOO TREATING VARIOUS HAIR PROBLEMS

Riya Suryakant Patil1, Siddhi Sandeep Patil2, Momin Abrarul Haque3 Dipesh Pramod Patil4 2023 gives detail about how effectively herbal shampoo are used to treat numerous hair issues such as dandruff which is caused by yeast Malasezzia .It is also used to treat hair loss which is a common issue nowadays. It also moisturizes the dry hair and treats split ends. Herbal shampoos also reduce excessive sebum production which leads to oily scalp. It also reduces frizzy hair and greasiness of the hair.[81]

3. AIM AND OBJECTIVE

1. To establish a safe and effective herbal shampoo recipe with only natural ingredients to improve the overall scalp health.

2. To formulate shampoo with cleansing and moisturizing ability.

3. To formulate and evaluate Herbal shampoo and to perform a comparative study with the Botanic Hearth Argan Keratin Shampoo in order to determine possible advantages of Herbal formulation.

4. To come up with environment friendly and sustainable alternative to marketed shampoos.

4 . EXPERIMENTAL WORK

4.1 MATERIAL AND METHODS

4.1.1 COLLECTION OF SAMPLE:

Table no.1 ACTIVE INGREDIENTS

Sr.No	INGREDIENTS	NAME OF COMPANY
1.	Triphala	MR Ayurveda
2.	Shikakai	Purenso
3.	Bhringraj	Purenso
4.	Sariva	Purenso

Table no .2 EXCIPIENTS

Sr.No	IINGREDIENTS	NAME OF COMPANY
1.	Panthenol Vitamin B5	Art Connect
2.	Polyquaternium-7	Artikamart
3.	Decyl glucoside	Art Connect
4.	Cocoamido propyl betaine	Art Connect
5.	Cocoglucoside	Artikamart
6.	Sodium methyl cocyl taurate	Artikamart
7.	Mandarin oil	Art Connect
8.	Rosemary oil	HerbShanti
9.	Magnesium nitrate	Spectrum
10.	Citric acid	Crown
11.	Guar gum	Flavour Drum
12.	Phenoxy ethanol	Purenso

Table No.3 INSTRUMENTS

Sr.No	INSTRUMENT NAME	NAME OF COMPANY
1.	pH meter	Hanna Instrument
2.	Viscometer	Fungilab
3.	Hot plate	Dolphin
4.	Weighing balance	Dolphin

4.1.2 ACTIVE INGREDIENTS DETAILS

TRIPHALA

(Sanskrit: tri = three and phala = fruits) is a well-known and venerated polyherbal medication comprised of dried fruits of three plant species: Emblica officinalis (Amlaki, Family Euphorbiaceae), Terminalia bellerica (Bibhitaki, Family Combretaceae), and Terminalia chebula (Haritaki, Family Combretaceae).[17]

Chemical constituents: Gallic acid, Ellagic acid, Vitamin C, Chebulinic acid, Ascorbic acid, Bellericanin.[17]

Figure 2 Triphala [19]

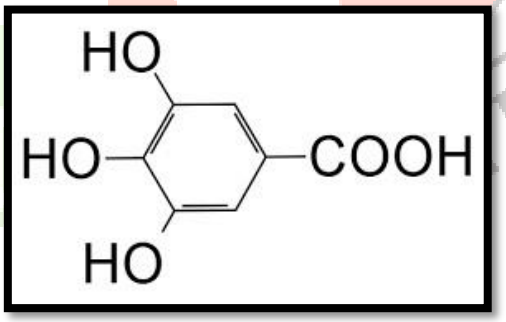


Figure 3 Gallic acid [18]

USES:

1. Increase hair volume
2. Promotes hair growth
3. Promotes natural shine
4. Nurtures hair roots
5. Minimize frizz
6. Prevent splitting ends[20]

SHIKAKAI

It is also known scientifically as Acacia concinna, is a shrub- like tree found in Central India.Acacia concinna (Leguminosae) is a climbing shrub that produces oblong dark brown pods, bipinnate leaves, and pink flowers.[21]

Figure 4 Role of shikakai [24]

Chemical constituents: Fatty acids are the main constituents contains Oleic acid and Steric acid , Saponins, Triterpenoids.[23],

Figure 5 Shikakai [22]

USES:

1. Greater radiance
2. Reduced baldeness
3. Avoid becoming dry
4. Manage hair loss
5. Encourages quicker hair growth.
6. Stenghtens the hair[21]

BHRINGRAJ

It is also known as Eclipta Alba. It is an annual herbaceous plant in Asteraceae family. It has been used for a long time as part of traditional medicines for diseases particularly involving hairs.[25]
Chemica constituents : Alkaloids, Saponin, Sterols, Flavenoids, Terpenoids and their glycoside, Phenolic acid, Coumestans.[25]

Figure 6 Bhringraj [26]

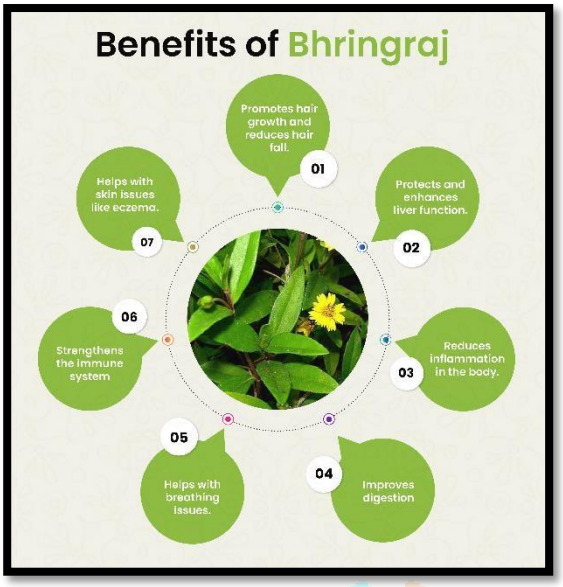


Figure 7 Role of Bhringraj [27]

USES:
Prevents Hair loss
Thinning of hair
Premature graying
Itching on the scalp
Promotes hair growth
Improve the scalp health[25]

SARIVA

Also known as Anantmool . Traditional herb Anantamool is a member of Apocynaceae family referred to Sarsaparilla Indian. Indian sarsaparilla is another name for sariva. It's not the same as sarsaparilla .The scientific term for it is Hemidesmus indicus. It is frequently utilized in the Ayurvedic medical system to treat a variety of illnesses.[28]

Chemical constituents: Terpenoids. Flavenoids, Benzoid derivatives, Glycosides, Steroids, Tannins.[28]

Figure 8 Hemidesmus indicus[29]

Figure 9 Role of Hemisdesmus indicus[30]

USES:

1. Helps to relieve itching of the scalp
2. Improve hair growth
3. Nourishes hair strands
4. Provides cooling effect after wash
5. Stenghthens the hair[28]

4.1.3 EXCIPIENTS PROFILE:

Table no.4

(A) PANTHENOL VITAMIN B5 [33]

Chemical Name	Panthenol Vitamin B5
Synonym	D-pantothenic acid
Mol.Weight	219.23g/mol
Empirical Formula	C9H17NO5
Functions	Natural humectant, helps balance moisture content in hair, emollient, strengthening agent
Incompatibilty	Avoid strong acids, bases. Avoid reaction with oxidizing agents, alkali metals.
Storage	Glass container, store in original containers.

(B) POLYQUATERNIUM-7 [39]

Chemical Name	Polyquaternium-7
Synonym	2-propen-1-ammonium,N,N-Dimethyl-N-2-propenyl-chloride, polymer with 2-propanamine
Mol.Weight	159 g/mol / 318 g/mol
Empirical Formula	C11H21C1N2O
Functions	Having anti static property and known to form thin coating on strands hence widely used in hair care product.
Incompatibilty	Strong oxidizing agents, strong bases and acids
Storage	Dry and cool place and protect from heat.

(C) DECYL GLUCOSIDE [43]

Chemical Name	Decyl glucoside
Synonym	Decyl-B-D-glucopyranoside
Mol.Weight	320.42g/mol
Empirical Formula	C16H32O6

Functions	Non-ionic surfactant used in foaming, cleansing, conditioning agents.
Incompatibilty	Anionic surfactants
Storage	Safe handling, clean and dry area.

(D) COCOAMIDO PROPYL BETAINE [48]

Chemical Name	Cocoamido propyl betaine
Synonym	Cocyl amide propyl di methyl glycine solution.
Mol.Weight	342.51662 g/mol
Empirical Formula	C19H38N2O3
Functions	Synthetic detergent, conditioning, thickening and foaming agent.
Incompatibilty	Having excellent compatibility with other ingredients.
Storage	Dry and tightly closed container in well ventilated area.

(E) COCOGLUCOSIDE [51,52]

Chemical Name	Cocoglucoside
Synonym	D-glucopyranose oligomeric
Mol.Weight	320.42168
Empirical Formula	C16H32O6
Functions	Natural surfactant, mild cleanser, natural moisturizer.
Incompatibilty	Having wide range of compatibility and can be combined with all type of surfactants without reducing foaming and cleansing ability.
Storage	Cool, dark and dry place.

(F) SODIUM METHYL COCYL TAURATE[56]

Chemical Name	Sodium methyl cocyl taurate
Synonym	Sodium N-Coconut Acid-N-Methyl Taurate Aqueous.
Mol.Weight	182.306 g/mol
Empirical Formula	C11H22N2
Functions	Used in variety of hair care products including adult and baby shampoos, conditioners, and styling products. Also used in hair color, hair bleaching and hair loss treatment. Cleanses the scalp without causing dryness.
Incompatibilty	It is highly compatible ingredient.

Storage	Tightly closed container, dry and well ventilated area away from ignition sources.

(G) MANDARIN OIL [60]

Chemical Name	Mandarin oil
Synonym	Tangerine, true Mandarin, Citrus reticulate, naartjie
Mol.Weight	136.24 g/mol
Empirical Formula	C10H16
Functions	Revives copper color tones, cleanses oily hair, restores dull hair to bring it back to life.
Incompatibilty	Srtrongly oxidizing and reducing agents.
Storage	Store in a cool, dark and dry place

(H) ROSEMARY OIL [63]

Chemical Name	Rosemary oil
Synonym	Rosemarinus angustifolius Mil and Salvia rosmarinus schield
Empirical Formula	Not known
Functions	Anti inflammatory and anti oxidant properties, promotes nerve growth, and improve blood circulation. Prevents the hair follicle from losing blood supply and falling off.
Incompatibilty	No incompatibility found.
Storage	Avoid storage near extreme heat, ignition sources or open flame. Store away from foodstuffs and oxidizing agents.

(I) MAGNESIUM NITRATE[66]

Chemical Name	Magnesium nitrate
Synonym	Magnesium dinitrate, Nitric acid, magnesium salt.
Mol.Weight	148.32 g/mol
Empirical Formula	Mg(NO3)2
Functions	Leaves the hair easy to comb, supple, soft, shiny and imparts volume.
Incompatibilty	With strong alkalis, strong reducing agents, fine powdered metals, mild steel.
Storage	Store in a cool, dry well-ventilated area. Keep away from incompatible materials.

(J) CITRIC ACID [69]

Chemical Name	Citric acid
Synonym	Anhydrous 2-hydroxypropane-1,2,3-tricarboxylic acid, Anhydrous citric acid
Mol.Weight	192.12 g/mol
Empirical Formula	C6H8O7
Functions	Maintains pH level and improves the hair appearance and manageability by reducing the frizziness. Helps to lift the hair and fade colors of the hair.
Incompatibilty	Oxidizing agents
Storage	Store in a cool and dry place. Provide ventilation. Avoid storage near extreme heat and ignition sources or open flames.

(K) GUAR GUM [73]

Chemical Name	Guar gum
Synonym	Jaguar gum, Guar flour and Decorpa
Mol.Weight	535.145 g/mol
Empirical Formula	C10H14N5Na2O12P3
Functions	Thickening power in haircare product. Coats individual hair in transparent sheen leaving a fuller, silkier appearance. Strengthens the hair and protects from split ends and breakage.
Incompatibilty	Insoluble in hydrocarbons, alcohols, esters, and organic solvents.
Storage	Store in a cool and dry place in tightly closed container. Store in a wellventilated area away from incompatible substances.

(L) PHENOXY ETHANOL [77]

Chemical Name	Phenoxy ethanol
Synonym	Ethylene glycol monophenyl ether.
Mol.Weight	138.16 g/mol
Empirical Formula	C8H10O2
Functions	Helps to prevent fungi, bacteria, yeast from growing in the product. Also provides long shelf life and ensures safety.
Incompatibilty	Good compatibility with anionic surfactants as well as non-ionic surfactants. Ethoxylated surafactants may lead to loss of the effectiveness.
Storage	Protect from frost, heat and direct sunlight. Store at room temperature in original container.

4.1.4 APPARATUS: Beaker(10ml,25ml,50ml,100ml,500ml), Glass Rod, Measuring cylinder(100ml,10ml), Petri dish, Conical flask, Dropper, Pipette, Funnel, Condenser, Round Bottom Flask, Soxlet apparatus, inlet outlet pipes, Filter paper, Stop watch, Heating mantle.

4.1.5 COLLECTION OF THE PLANT:

All the Ingredients were ordered online from the various websites named Art connect, Artikamart, Amazon, and Purenso. All extracted products were purchased online except Triphala which was extracted in lab following standard extraction procedure.

4.1.6 EXTRACTION OF CRUDE DRUG (TRIPHALA):[5]

Soxhlet extractor system includes RBF (round bottom flask) tube, distillation channel, condenser, cooling water intake and outlet, heat source. In this powdered sample was encased in a porous bag or muslin cloth which is placed in the thimble chamber of soxhlet apparatus. The extraction solvent is placed in RBF and heated using a heating source, such as a heating mantle. The heating temperature is based on the solvent used for extraction. Due to heat, the solvent in the bottom flask vaporizes into the condenser and drips back into the sample thimble. When the liquid content reaches the siphon arm, it is poured back into the bottom flask, and the procedure is completed. This method uses heat from the distillation flask to maintain a relatively high extraction temperature. No filtration of the extract is required.

FIGURE 10 SOXHLET EXTRACTION

FIGURE 11 SOXHLET EXTRACTION PROCESS

4.1.7 FORMULATION AND OPTIMIZATION OF HERBAL SHAMPOO

The Herbal shampoo were prepared by making two separate phases in which one phase was containing mixture of guar gum and all Extracts and another one containing all excipients except sodium methyl cocyl taurate.

BEAKER NO: 01

1. Firstly dissolve the guar gum or dispersed it in water
2. Heat the mixture to form a thick paste.
3. Now in this mixture add Polyquaternium-7 and mix slowly with glass rod.
4. Then add all four Extracts i.e. Triphala, Shikakai, Bhringaraj, Sariva in the beaker and at last add Pantherol Vitamin B5.

BEAKER NO: 02

5. In this beaker weigh Mandarin oil and Rose merry oil.
6. Now weigh and, add all excipients and surfactants i.e. Cocoglucoside, Decyl glucoside, Cocoamidopropyl betaine.
7. Do not add Sodium methyl cocyl taurate in this beaker because they are dry ingredients they will cause formation of lumps which will cause phase separation.

BEAKER NO: 03

8. Now gently mix ingredients of beaker 1 and 2 in 3rd beaker. Heat the mixture to form uniform paste. Take small quantity to avoid phase separation and also mix gently to avoid formation of foam.
9. At last add pH stabilizers i.e. citric acid and to avoid spoilage of formulation add Phenoxy ethanol which will act as preservatives.
10. Now at last place the beaker on ice bath to reduce heat and to form a good consistency of shampoo.

Overall, the formulation procedure involved the preparation of base, incorporation of the herbal Extracts, Homogenization, and pH adjustments, Evaluation, Optimization and Production of the Final Product.

OPTIMIZATION OF HERBAL SHAMPOO

Table No. 5 Formula table

INGREDIENTS	F1 (g)	F2 (g)	F3 (g)	F4 (g)	F5 (g)	F6 (g)	F7 (g)	F8 (g)	F9 (g)
Triphala	1	1	1	1	1	1	1	1	1
Shikakai	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Bhringraj	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Sariva	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Panthenol vitamin B5	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**

Cocoamidopropyl betaine	3	3	3	3	3	3	3	4.5	9
Sodium methyl cocyl taurate	6	6	6	6	6	6	6	6	6
Decyl glucoside	3	3	3	3	4.5	9	3	3	3
Cocoglucoside	3	4.5	9	4.5	4.5	4.5	4.5	4.5	4.5
Polyquaternium-7	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Citric acid	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Magnesium nitrate	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Mandarin oil	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Rosemary oil	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Guar gum	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Phenoxy ethanol	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

4.1.8 EVALUATION OF HERBAL SHAMPOO:[5]

The prepared herbal shampoo was subjected to physical characterization such as color, appearance, pH, Viscosity, Spreadability.

4.1.8.1 PHYSICAL PARAMETER:[14]

Color-:

The formulation colors were evaluated against white background.

 Consistency-:

The consistency of formulation was checked by applying on the skin

4.1.8.2 DETERMINATION OF PH:[14]

- Make a dilute solution of shampoo, measure the pH with pH paper, and adjust the pH to scalp requirements.
- Using standard buffer solution, the pH meter was calibrated. The pH of shampoo was measured after weighing 1g of shampoo and dissolving it in 50.0 ml of distilled water.

4.1.8.3 DETERMINATION OF VISCOSITY:[14]

 Using a Brookfield viscometer, the viscosities of shampoo formulation were measured.

4.1.8.4 SPREADABILITY:[14]

 To assess the diffusibility of all formulations, two standard- sized glass slabs were used. 1gm of shampoo was placed between two glass slabs and about 10gm of weight was attached to the upper glass plate. The collection had remained upright throughout. The time taken to separate the slab is calculate.

4.1.8.5 STABILITY STUDIES:[14]

- The stability research was carried out. The prepared shampoos were placed inside a glass container and kept at a constant temperature and humidity level. (i.e. room temperature)
- After several days several parameters of shampoos like appearance, spread ability, viscosity, pH, colour.

4.1.8.6 CLEANSING:[14]

 Formulation were dissolved in distill water and hair cover in grease were put in the water containing shampoo and shake for 4 min to calculate cleansing activity.

4.1.8.7 FOAMING:[14]

- 1gm of shampoo in 100ml of water and shake for some time and foaming power is calculated.

4.1.8.8 WETTING TIME:[14]

- Filter paper were cut in 1inch diameter and average wetting time is calculated.

4.1.8.9 PERCENTAGE OF SOLID CONTENT:[14]

 Petri dish was weighed and amount of formulation is added and placed on hot plate and solid content is calculated after drying.

5. RESULT:

5.1 EXPERIMENTAL:

5.1.1 CHARACTERISTICS OF EXTRACT

The physical state, color, odour of the different extract used in formulation

5.1.2 EVALUATION OF HERBAL SHAMPOO:

The shampoo was determined visually like color, odor, homogeneity, pH of all the formulations. The results are shown in the given table:

Table No. 6

Formulation	Characteristics			
	Colour	**Odour**	**Homogeneity**	**pH**
F1	Brown	Sweet and Aromatic	Aggregate	6.4
F2	Brown	Sweet and Aromatic	Aggregate	7.1
F3	Greenish Brown	Sweet and Aromatic	Aggregate	7.3
F4	Brown	Sweet and Aromatic	Slightly aggregate	7.6
F5	Greenish Brown	Sweet and Aromatic	Slightly aggregate	7.0
F6	Greenish Brown	Sweet and Aromatic	Slightly aggregate	6.0
F7	Greenish Brown	Sweet and Aromatic	Absence of aggregate	7.2
F8	Brown	Sweet and Aromatic	Absence of aggregate	5.6
F9	Brown	Sweet and Aromatic	Absence of aggregate	5.2

5.1.3 DETERMINATION OF CLEANSING ACTION [14]

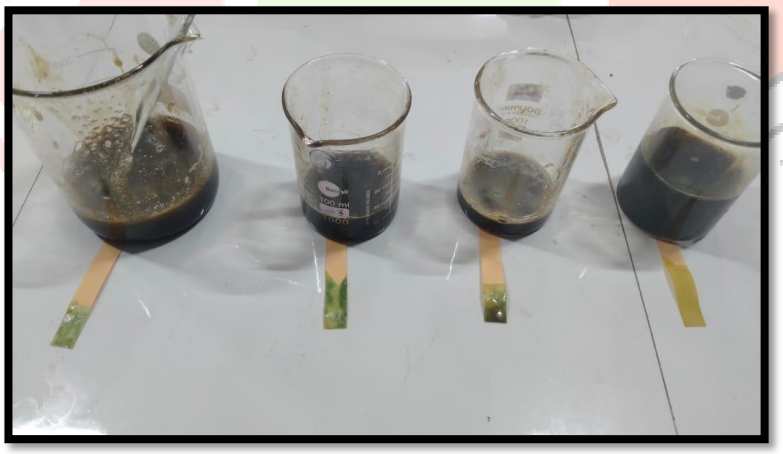
Cleansing ability of the shampoo was determined by first taking 5g of the hair and dipping it into oil. Weight was taken. Further the hair was washed using the shampoo and weighed again.

Sr.No.	Formulation	Cleansing ability
1.	F1	12g
2.	F2	12.5g
3.	F3	12.7g
4.	F4	13g
5.	F5	13.5g
6.	F6	14g
7.	F7	14.2g
8.	F8	14.5g
9.	F9	15g

CLEANSING ABILITY

5.1.3 DETERMINATION OF pH:[14]

The pH of all the prepared formulation ranged from 5 to 7. The prepared shampoo formulation's pH was determined to be suitable to reduce the chances of scalp irritation when applied to hair. The outcome were displayed in Table no 6.



pH OF SHAMPOO

5.1.4 DETERMINATION OF VISCOSITY:[14]

Viscosity is a fluid property that describes a liquid's resistance to flow and is linked to internal friction within fluid. This rheological characteristic aids in the determination of consistency as well as the rate of drug diffusion from shampoo. The viscosity of the produced shampoo was measured using a Brookfield viscometer with spindle speed from 0.3 to 10 rpm. Table no 7 displays the findings

Table no 7

Sr.No.	Formulation	Viscosity (CPS)
1.	F1	15765.00
2.	F2	10874.86
3.	F3	76782.09
4.	F4	8765.98
5.	F5	54571.00
6.	F6	49832.00
7.	F7	51514.33
8.	F8	24906.00
9.	F9	10986.88

5.1.5 DETERMINATION OF SPREADABILITY:[6]

Spreadability refers to how far the shampoo spreads after being applied to scalp. The spreading was measured by placing the 1g of shampoo between the two slide and put under a 10gm of load. The spreadability of various shampoo was investigated. The spreadability of formulation F6 and F9 was higher than that of the other formulation. Table displays the findings.

Table no 8

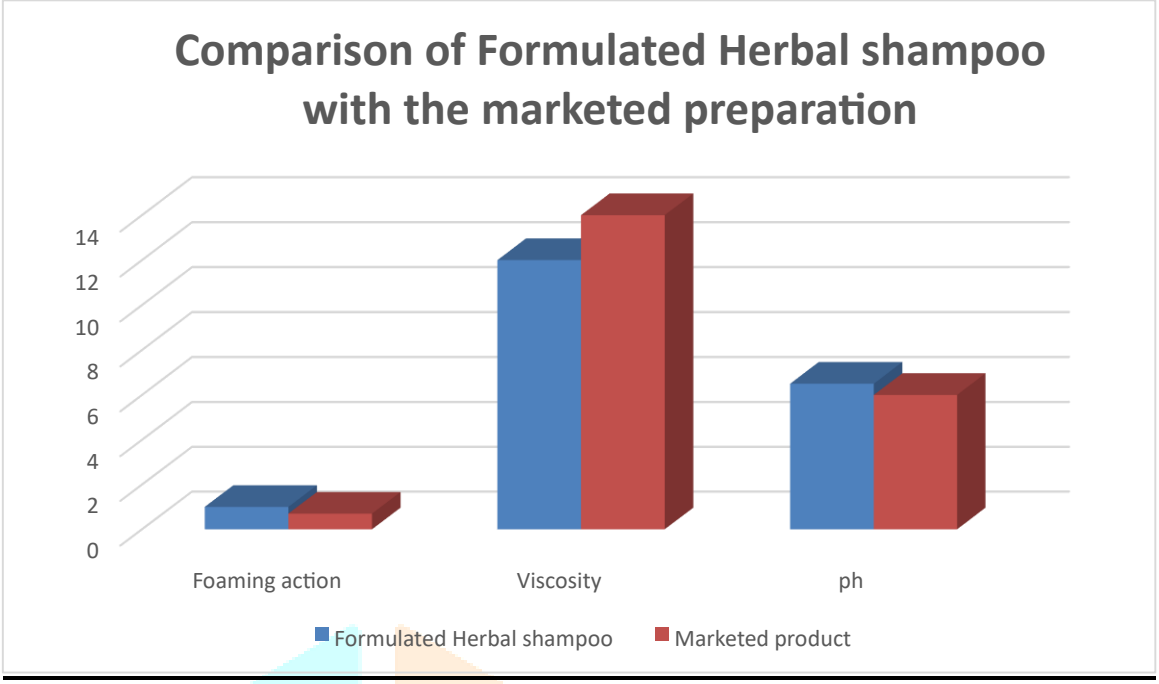
Sr.No	Formulation	Spreadibilty(in mm)
1.	F1	24mm
2.	F2	26mm
3.	F3	28mm
4.	F4	30mm
5.	F5	29mm
6.	F6	32mm
7.	F7	30mm
8.	F8	30mm
9.	F9	32mm

SPREADABILITY OF SHAMPOO

COMPARISON OF FORMULATED HERBAL SHAMPOO WITH THE MARKETED PREPARATION : [3]

Physicochemical evaluation of formulated and marketed shampoo

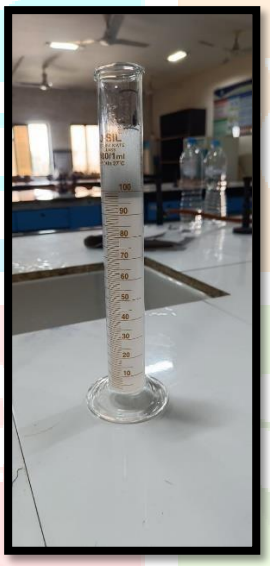
Parameters	Formulated shampoo	Marketed preparation
Color	Brown	Pure White
Odour	Sweet and aromatic	Aromatic
pH	7.2	6
Viscosity	51514.33cps	45742.00cps
Cleansing action	14.2g	16.3g
Spreadability	30mm	27mm
Foaming ability	1.0	0.7
Wetting time	4 sec	7 sec
Percent of solid content	2%	3%



5.1.6 EVALUATION OF MARKETED PREPARATION:

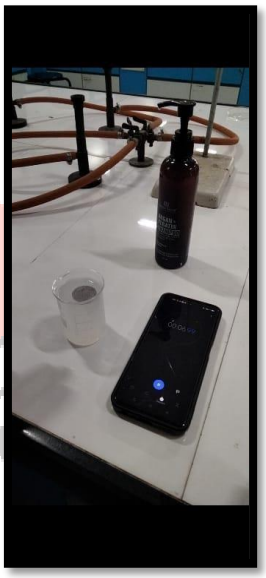
Evaluation test	Result
Determination of Color	White
Determination of Odour	Aromatic
Determination of Consistency	Thick
Determination of Spreadability	Easily Spreadable (27 mm)
Determination of Washability	Easily Washable
Determination of pH	6
Determination of Viscosity	45742.00 cps
Wetting time	7 seconds
Percent of solid content	3%
Cleansing action	16.3g
Foaming power	0.7

BOTANIC HEARTH ARGAN AND KERATIN SHAMPOO [82] EVALUATION TESTING:



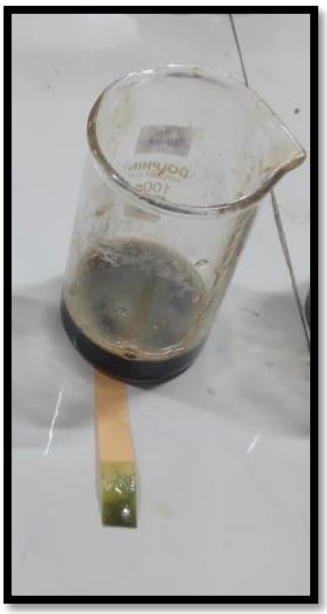
FOAMING ABILITY

CLEANSING ACTION



WETTING TIME

PERCENTAGE OF SOLID CONTENT



DETERMINATION OF PH

6. DISCUSSION

Extraction of Triphala was performed. The shampoo was formulated by mixing dry and wet ingredients in different beakers. The shampoo was prepared by using different extracts like Shikakai, Bhringhraj, Triphala, and Sariva. Formulation of shampoo was done by using different extracts and supporting excipients like Pantherol Vitamin B5 which hydrates and soothes dry and irritated scalp while gentle cleansing, Poly-quaternium 7 is used as moisturizing agent and improve compatibility with other surfactant, Cocoamidopropylbetaine is used as foam booster and also helps in conditioning and moisturizing hair, Sodium methyl cocyl taurate used as natural substitute to harsh surfactant, Decyl glucoside is used as a gentle cleanser and cleanse scalp and oily hair without irritation, Cocoglucoside same as decyl glucoside i.e. gentle cleanser, Citric acid is used as pH stabilizer, Mandarin oil contain calming property and used as perfuming agent, Rosemary oil used as perfuming agent, Phenoxyethanol is added to maintain stability i.e. it act as preservatives.

The formulated shampoo was too watery i.e. having low viscosity, formation of lumps, on storage settling of extract etc. so we have prepared total 9 batches in which starting F1 and F2 batch were found formation of lumps of Sodium methyl cocyl taurate when we mixed directly with liquid surfactant. In F3 and F4 batch we followed same procedure but the Sodium methyl cocyl taurate were added in small batches to avoid aggregation of formulation. Now in F5 and F6 batch the viscosity of the formulation was not appropriate so we increased the percentage of Guar gum. For the evaluation of shampoo formulation we have done all different standard parameters used to evaluate shampoo formulation like, (pH, viscosity, spreadibility, foaming, cleansing, and wetting time, percentage of solid content, stability studies). The formulation F7, F8 and F9 showed near to equal result as compared to other formulation (F1, F2, F3, F4, F5, and F6).

The main purpose of formulating this shampoo was to make 100% natural shampoo which will be market fit less or no side effect and also economical for all consumer. As this formulation does not contain any harmful synthetic chemicals which are very dangerous and cause many side effects like hair fall, itchy scalp and excessive formation of dandruff. Several physical and other evaluations

were done on the formulation which shows satisfactory result for being used on Human hair but further studies and tests like Research and Clinical Trail, etc are required to make it more reliable and good quality product for Human use.

Formulation was studied for different parameters like Appearance, pH.etc. It showed no physical changes on storing at room temperature. It was found that the formulation of shampoo is stable at room temperature for 1 month and it can be predicted that the formulation of shampoo can be stable till 3 months if stored in cool & dry place and without contaminating the cap of shampoo container.

7. CONCLUSION

- The review emphasizes the utilization and significance of herbal shampoo, shedding light on the awareness and the demand for cosmetics products with herbal ingredients. The belief in the safety and absence of side effects in herbal products is highlighted. The focus is on various aspects, including types, preparation method, and evaluation of polyherbal shampoos.

- The study aimed to create a herbal shampoo that minimizes hair loss during combing, providing a safer alternative to chemical conditioning agents while promoting hair growth.

- The formation includes aqueous extracts of medicinal plants traditionally used for hair cleansing. Instead of synthetic cationic conditioners, the study utilizes Shikakai, Bhringraj and other natural extracts to enhance conditioning effects[12]

- The investigation aimed to develop a stable and functionally effective shampoo without synthetic additives commonly found in such formulations. Multiple test were conducted to ensure good product performance, revealing comparative results for quality control, through future scientific validation is necessary for overall quality assessment.[12]

8. FUTURE SCOPE

- Herbal products like herbal beauty product, herbal hair care product like Lipstick, Foundation, Powder, and Shampoo which has property of conditioning.
- The increased demand for chemical free hair and skin product are growing awareness about cosmetic products and supporting market growth.

- The significant rise in the influence of social media and beauty blogs that are communicating the benefits of herbal beauty and hair product is likely to influence sales of herbal hair products.

- Moreover, herbal beauty and hair product are suitable for all types of skin, which influence the sales of herbal hair product such as hair product shampoo improving distribution network are pivotal in driving the market growth.

- The consumer indication toward healthier lifestyle and the growing demand for product with low environmental impact drive market growth.

- Herbal hair shampoo which is formulated by chemical free natural ingredient such as Triphala, Shikakai, Bhringhraj, Sariva, etc. are having marvelous cleansing and conditioning property.

- Natural ingredient like Mandarin oil and Rosemary oil used for aroma of shampoo overall it has broad and successful present and as well as future it has left strong impact in population because indeed it is free from chemicals and side effects.

- Stability studies for herbal shampoo and interaction between different extracts and excipients can be studied.

9. REFERENCES

1. Nipurte, S., Datir, M. B., & Fulsundar, A. S. (2022). A REVIEW ON FORMULATION AND EVALUATION OF HERBAL SHAMPOO 1 *Disha. *Certified Journal* | *Nipurte et al. World Journal of Pharmaceutical Research*, *11*, 412. https://doi.org/10.20959/wjpr20223-23171

2. Vijayalakshmi, A., Sangeetha, S., & Ranjith, N. (2018). Formulation and evaluation of herbal shampoo. *Asian Journal of Pharmaceutical and Clinical Research*, *11*(Special Issue 4), 121–124. https://doi.org/10.22159/ajpcr.2018.v11s4.31713

3. al Badi, K., & Khan, S. A. (2014). Formulation, evaluation and comparison of the herbal shampoo with the commercial shampoos. *Beni-Suef University Journal of Basic and Applied Sciences*, *3*(4), 301–305. https://doi.org/10.1016/j.bjbas.2014.11.005

4. Reddy, Vs., & Rao, Km. (n.d.). *SHAMPOOS: AN OVERVIEW*. www.ijapronline.org

5. Maurya, P., Maury, S., Yadav, P., Yadav, K., Maurya, S., & Jaysawal, S. (2021). *A REVIEW ARTICLE ON: HERBAL SHAMPOO* (Vol. 8). www.jetir.org

6. Dr. Sanju Nanda, Dr. Arun Nanda, Dr. Roop K.Khar Cosmetic technology Birla Publication.

7. Mukund B Bandale. Anatomical review of hair W.S.R. to hair cosmetics. MedPulse – International Medical Journal. July 2020; 7(7): 05-09. http://www.medpulse.in

8. Dr. Satya Prakash Singh, Dr. Vijay Nigam Thakur Publication Private Limited, 2021

9. Madaan, A., Verma, R., Singh, A. T., & Jaggi, M. (2018). Review of Hair Follicle Dermal Papilla cells as in vitro screening model for hair growth. In *International Journal of Cosmetic Science* (Vol. 40, Issue 5, pp. 429–450). Blackwell Publishing Ltd. https://doi.org/10.1111/ics.12489

10. https://rejuvenatehairtransplant.com/blog/hair-structure/ Figure 9 Hair anatomy

11. *A REVIEW ON HERBAL SHAMPOO 1Janrao kaveri, 2Gaikwad Vishal Shivaji 1Students , 2Assistant Professor 1DBATU*. (2022). www.ijcrt.org

12. Nikita somnath, K., D, H. L., & Khade B, M. P. (n.d.). "Formulation and Evaluation of Herbal Shampoo." *International Journal of Pharmaceutical Research and Applications*, *8*, 1869. https://doi.org/10.35629/7781-080318691882

13. Srivastava, N. (2013). Formulation and evaluation of herbal shampoo having antimicrobial potential. In *Article in International Journal of Pharmacy and Pharmaceutical Sciences*. https://www.researchgate.net/publication/286999802

14. Singh Rathore, K., & Bharkatiya, M. (2019). CODEN(USA): PCJHBA Formulation and Evaluation of Herbal Shampoo by Extract of Some Plants. In *Article in The Pharmaceutical and Chemical Journal*. https://www.researchgate.net/publication/349950407

15. Patel, I., & Talathi, A. (2016). " USE OF TRADITIONAL INDIAN HERBS FOR THE FORMULATION OF SHAMPOO AND THEIR COMPARATIVE ANALYSIS " Original Article "USE OF TRADITIONAL INDIAN HERBS FOR THE FORMULATION OF SHAMPOO AND THEIR COMPARATIVE ANALYSIS" Original Article. In *Article in International Journal of Pharmacy and Pharmaceutical Sciences*. https://www.researchgate.net/publication/296307869

16. Lodha, G. (2019). Formulation and Evaluation of Polyherbal Shampoo to Promote Hair Growth and Provide Antidandruff Action. *Journal of Drug Delivery and Therapeutics*, *9*(4-A), 296–300. https://doi.org/10.22270/jddt.v9i4-a.3474

17. Chouhan, B., Kumawat, R. C., Kotecha, M., Ramamurthy, A., & Nathani, S. (2013). Triphala: A comprehensive ayurvedic review. In *International Journal of Research in Ayurveda and Pharmacy* (Vol. 4, Issue 4, pp. 612–617). https://doi.org/10.7897/22774343.04433

18. https://upload.wikimedia.org/wikipedia/commons/8/8f/Gallic_acid.png Figure 10 Gallic acid

19. https://images.app.goo.gl/FxCBcBu62DdNveNaA Figure 11 Triphala

20. Peterson CT, Denniston K, Chopra D. Therapeutic Uses of Triphala in Ayurvedic Medicine. J Altern Complement Med. 2017 Aug;23(8):607-614. doi: 10.1089/acm.2017.0083. Epub 2017 Jul 11. PMID: 28696777; PMCID: PMC5567597.

21. Aqif, M. S., & Borhade, M. A. (2022). Formulation and Evaluation of Shikakai Shampoo. *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT*, *2*(1). https://doi.org/10.48175/568

22. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.flickr.com%2Fphotos%2Fwwwssncomphotos%2F14184339438&psig=AOvVaw1hv2kZG7myLQKEkS1GxO0e&ust=1715674122171000&source=images&cd=vfe&opi=89978449&ved=0CBAQjRxqFwoTCNCGsLGWioYDFQAAAAAdAAAAABAE

Figure 5 Shikakai

23. Itkaan, K., Singh, A., Pathan, K., & Jagtap, M. M. (2022). Medicinal Plant of Shikakai. *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT) International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal*, *2*(7). www.ijarsct.co.in

24. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.bebeautiful.in%2Fa ll-things-hair%2Feveryday%2F8-reasons-why-shikakai-is-good-for-yourhair&psig=AOvVaw0a30NOY9bUHMFSE1-8mLQJ&ust=1715675440034000&source=images&cd=vfe&opi=89978449&ved=2ahUKEwiVor-am4qGAxUoSGwGHZQFDDcQjRx6BAgAEBQ
Figure 12 Role of shikakai

25. Ayurveda, S. (2021). *ECLIPTA ALBA (BHRINGRAJ): A PROMISING HEPATOPROTECTIVE AND HAIR GROWTH STIMULATING HERB. ISHA KUMARI, HEMLATA KAURAV, GITIKA CHAUDHARY*. 14*, 2021. https://doi.org/10.22159/ajpcr.2021v14i7.41569

26. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.ebay.com%2Fitm%2F185988576647&psig=AOvVaw0Y7O1ViTVXcF8S0ox85M4P&ust=1715676447025000&source=images&cd=vfe&opi=89978449&ved=2ahUKEwi6kdX6noqGAxX5UGwGHXdLALwQjRx6BAgAEBQ
Figure 6 Bhringraj

27. https://www.thewellnesscorner.com/blog/bhringraj Figure 13 Role of Bhringraj

28. Br KManjulatha, R. (n.d.). *Phytochemistry, Pharmacology and Therapeutics of Hemidesmus indicus*.

29. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.shutterstock.com%2Fimage-photo%2Fhemidesmus-indicus-known-ananthamoola-naruneendi-nannari1207646020&psig=AOvVaw3FhG9yR868c1LQXZklbC5Q&ust=1715678687367000&source=images&cd=vfe&opi=89978449&ved=2ahUKEwju3fimp4qGAxWWUGwGHUGlDTMQjRx6BAgAEBQ
Figure 14 Hemidesmus indicus

30. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.amazon.in%2FIagri farm-Anantmool-Nannari-Anantamul-Hemidesmus%2Fdp%2FB0B2WW19PJ&psig=AOvVaw2KHfBFeX9E8JKPdPWJ1gHi&ust=1715678727671000&source=images&cd=vfe&opi=89978449&ved=2ahUKEwiG3ZS6p4qGAxWBbmwGHakkBmYQjRx6BAgAEBQ
Figure 9 Role of Hemisdesmus indicus

31. https://go.drugbank.com/drugs/DB01783
32. https://pubchem.ncbi.nlm.nih.gov/compound/Pantothenic-Acid

33. https://www.google.com/url?q=https://datasheets.scbt.com/sc-252763.pdf&sa=U&ved=2ahUKEwim1oPg4vWEAxVed_UHHetKCIYQFnoECA8QAQ&usg=AOvVaw2j5zNZ-xMM79h73xk4htgu
34. https://www.ewg.org/skindeep/ingredients/705124-POLYQUATERNIUM7/
35. https://www.iropolymer.com/Cosmetic/Polyquaternium-7.htm
36. https://www.chemsrc.com/en/cas/26590-05-6_178914.html
37. https://www.anveya.com/blogs/top-tips/polyquaternium-7-for-hair-and-skin
38. https://www.atamanchemicals.com/polyquaternium-7_u26526/
39. https://www.google.com/url?q=https://chemistryconnection.com/sds/data/pdf/Polyquaternium_7_-_SDS_CC.pdf&sa=U&ved=2ahUKEwi3zua5mYKFAxW-RmwGHU6JAmIQFnoECB8QAQ&usg=AOvVaw1o_KGwQ2QnnrEO8_1qAUJU
40. https://www.ewg.org/skindeep/ingredients/701883-DECYL_GLUCOSIDE/
41. https://pubchem.ncbi.nlm.nih.gov/compound/Decyl-glucoside
42. https://cosmetics.specialchem.com/inci-ingredients/decyl-glucoside
43. https://www.google.com/url?q=https://www.interchimie.fr/wpcontent/uploads/DECYL-GLUCOSIDE_EN.pdf&sa=U&ved=2ahUKEwjj0fTKoYKFAxVVZmwGHQl0D2MQFnoECBYQAQ&usg=AOvVaw3I7txR3cbw7SLQXbWikOJy
44. https://www.anveya.com/blogs/top-tips/cocamidopropyl-betaine-in-hair-careproducts
45. https://www.molinstincts.com/structure/Cocamidopropyl-betaine-cstrCT1024093983.html
46. https://www.anveya.com/blogs/top-tips/cocamidopropyl-betaine-in-hair-careproducts
47. https://www.kaochemicals-eu.com/products/cocamidopropyl-betaine
48. https://www.google.com/url?q=https://www.nwabr.org/sites/default/files/MSDS_Cocamidopropyl_betaine.pdf&sa=U&sqi=2&ved=2ahUKEwio99vgvoKFAxV1UGcHHdxgClMQFnoECC8QAQ&usg=AOvVaw3nDEs1fR2SLAMjfW5_PUaZ
49. https://www.chemnet.com/Suppliers/35385/Coco-glucoside--1485277.html
50. https://www.clinikally.com/blogs/news/power-of-coco-glucoside-a-secretingredient-for-lustrous-hair
51. https://www.ingredientstodiefor.com/item/Coco_Glucoside/1479
52. https://www.humblebeeandme.com/project/coco-glucoside/
53. https://www.upichem.com/products/sodium-methyl-cocoyl-taurate/
54. https://wap.guidechem.com/dictionary/en/12765-39-8.html
55. https://puracy.com/blogs/ingredients/sodium-methyl-cocoyltaurate#:~:text=Sodium%20Methyl%20Cocoyl%20Taurate%20is%20used%20in%20a%20variety%20of,causing%20excessive%20dryness%20or%20damage
56. https://www.google.com/url?q=https://www.makingcosmetics.com/on/demandware. static/-/Sites-makingcosmetics-master/default/dw08a2fe3b/msds/sds-sodium-methylcocoyl-taurate.pdf&sa=U&ved=2ahUKEwiu_rPKt4SFAxUagK8BHewTD7gQFnoECBAQBg&usg=AOvVaw3MYzYDljvsrfSdyG6upfB5
57. https://www.upichem.com/products/sodium-methyl-cocoyl-taurate/
58. https://www.aosproduct.com/ESSENTIAL-OILS/Manderian-Oil
59. https://hairborist.com/en/blog/mandarin-essential-oil/
60. https://www.google.com/url?q=https://www.essentialingredients.com/msds/Mandarin%2520Oil%2520Natural.pdf&sa=U&ved=2ahUKEwiSx6ngnoeFAxUut1YBHaj2Cr0QFnoECBIQAQ&usg=AOvVaw3pkiqk6tOBn79K5QTi-B9I

61. https://www.sciencedirect.com/science/article/pii/S0378874118314107#:~:text=Rosmarinus%20officinalis%20Linnaeus%20(1753%2C%20Lamiaceae,The%20Plant%20List%2C%202018)
62. https://www.health.com/rosemary-oil-for-hair-7568852
63. https://www.google.com/url?q=https://www.nowfoods.com/sites/default/files/7600rosemary-oil.pdf&sa=U&sqi=2&ved=2ahUKEwjoyIeNvYqGAxXqcvUHHTyNBO8QFnoECDUQAQ&usg=AOvVaw0sSqNkkeco4s_Ex4R0BkHw
64. https://pubchem.ncbi.nlm.nih.gov/compound/Magnesium-nitrate
65. https://cosmileeurope.eu/inci/detail/8546/magnesium-nitrate/
66. https://www.google.com/url?q=https://www.columbuschemical.com/MSDS/SDS/Magnesium%2520Nitrate%252067%2525%25203263.pdf&sa=U&ved=2ahUKEwjpyyPwoqGAxWpUGwGHXQ5BGAQFnoECB0QAQ&usg=AOvVaw1j1VrMUw6Dp9Mpzi-Wlzcc
67. https://pubchem.ncbi.nlm.nih.gov/compound/Citric-Acid
68. https://www.newdirectionsaromatics.com/blog/products/all-about-citric-acid-incosmetics-personal-care.html
69. https://www.google.com/url?q=https://www.fishersci.com/content/dam/fishersci/en_us/documents/programs/education/regulatory-documents/sds/chemicals/chemicalsc/s25255.pdf&sa=u&ved=2ahukewi92_ywxiqgaxwqsgwghe5ddjiqfnoecbqqbg&usg =aovvaw3rd_sj-9ppuvrjjlesdu53
70. https://www.pharmacy180.com/article/guar-gum-100/
71. https://m.chemicalbook.com/ChemicalProductProperty_EN_CB5253559.htm
72. https://www.bellchem.com/news/8r2o36j7ikbstu5n7su9tjpouj20z7
73. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/guargum#:~:text=Guar%20gum%20is%20insoluble%20in,form%20high%2Dviscosity% 20colloidal%20solutions
74. https://fscimage.fishersci.com/msds/89758.htm
75. https://pubchem.ncbi.nlm.nih.gov/compound/Phenoxyethanol
76. https://www.webmd.com/beauty/what-to-know-about-phenoxyethanol
77. https://www.google.com/url?q=https://www.andreagallo.it/images/schedepdf/TDS/Conservante_Fenossietanolo_%2520821722_tds_EN.pdf&sa=U&ved=2ahUKEwj8vZyP1IqGAxX8ha8BHdMXDXIQFnoECDQQAQ&usg=AOvVaw3cN0LuItPw4UPgaDAq8N2J

78. Rajput, A.-S. P., Khalse, R. B., & Rajput, S. P. (2023). FORMULATION OF HERBAL SHAMPOO AND ITS EVALUATION ABSTRACT. *International Journal of Creative Research Thoughts*, *11*, 2320–2882. www.ijcrt.org

79. *A REVIEW ON THERAPEUTIC POTENTIAL OF TRIPHALA MASHI*. (2024).

80. https://cdn.mdedge.com/files/s3fs-public/Document/January-2018/CT101001022.PDF
SKIN OF COLOR. (2018).

81. Patil, R. S., Sandeep Patil, S., & Haque, M. A. (2023). *A REVIEW ARTICLE ON HERBAL SHAMPOO* (Vol. 11). www.ijcrt.org

82. https://m.media-amazon.com/images/I/618JkwiSANL._SX679_.jpg

9. APPENDIX :

Bibliography : For successfully completing project work we have taken help from the following website:

- https://pubchem.ncbi.nlm.nih.gov
- www.google.com
- www.wikipedia.com
- Research papers
- Review articles
- You Tube

10. Published books:

Dr. Sanju Nanda, Dr. Arun Nanda, Dr. Roop K.Khar Cosmetic technology Birla Publication.

Dr. Satya Prakash Singh, Dr. Vijay Nigam Thakur Publication Private Limited, 2021