RESEARCH PAPER

Development and Physicochemical Evaluation of Polyherbal Dry Powder Shampoo Using Natural Ingredients for Healthy Hair

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ABSTRACT:

A person's appearance and self-confidence are greatly influenced by their hair. The growing use of synthetic hair care products has led to a number of hair issues, including dryness, dandruff, irritation of the scalp, and hair loss. Because they are safer, more natural, and have fewer negative effects than synthetic products, herbal formulations are becoming more and more popular. The creation and assessment of a polyherbal dry powder shampoo utilizing organic components like Neem, Aloe vera, Shikakai, Reetha, Hibiscus, Amla, Brahmi, Fenugreek, and Bhringraj is the main focus of this study. The powdered herbal constituents were dried, ground, and combined in varied ratios to create three distinct formulations (S1, S2, and S3). Physicochemical parameters, general powder features, and organoleptic properties were assessed for the produced formulations. The shampoo powder had a brownish color, a distinct smell, a smooth texture, and a faint taste, according to the organoleptic assessment. To assess flow qualities, general powder variables such particle size, angle of repose, bulk density, tapped density, Carr's index, and Hausner ratio were calculated. Foaming ability, pH measurement, skin irritation test, washability, solubility, and stability study were among the physicochemical properties that were also evaluated. According to the findings, the herbal shampoo's formulation demonstrated good foaming ability, an appropriate pH of 5–6, ease of washing, and no skin irritation. Throughout the trial time, the formulation did not change. Therefore, for maintaining healthy hair, the polyherbal dry powder shampoo made from natural ingredients can be regarded as an efficient, secure, and affordable substitute for synthetic shampoos.

KEYWORD: Traditional, Herbal Shampoo, Safety, Efficacy, Foaming ability, organoleptic assessment**.**

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INTRODUCTION:

Hair is an important component of human beauty. Human beings have used herbs to clean, beautify and manage hair since ancient times.(1) Hair is a complex structure made up of keratin, a fibrous protein, and serves various important functions in the human body, including protection, regulation of body temperature, and sensory input. Hair also plays a significant role in personal aesthetics and social identity. Hair care is an essential part of personal hygiene and grooming, ensuring that your hair remains healthy, shiny, and well-maintained. Whether you have long, short, curly, straight, or textured hair, proper hair care is crucial to avoid damage, breakage, and hair loss. A good hair care routine consists of several key steps: cleansing, conditioning, and moisturizing.(2) Hair-care pro

ducts can be characterized as preparations designed to cleanse, alter the texture, change the color, revitalize stressed hair, nourish it, and give it a healthy appearance. (3) Tension, scalp infections, hormone imbalances, diet, and heavy chemical shampoo use are the causes of hair problems. In this regard, we are introducing polyherbal shampoo, a multipurpose hair treatment with fewer adverse effects that can be used on a daily basis. (4) This century saw the development of actual hair and scalp cleansing technologies with the advent of cake soap and the manufacturing of shampoo products. (5) The primary motivation behind the creation of shampoo products is people's need for proper cleanliness and their care for their beauty. Under some circumstances, the shampoo removes surface grease, filth, and skin debris from the hair shaft without harming the users. (6) There are a lot of synthetic, herbal, medicated, and non-medicated shampoos on the market these days, but customers are becoming more interested in herbal shampoos since they think these natural products are safe and have no negative side effects. [7] Shampoos are of various types, like

1. Conventional Shampoo
   - Liquid Shampoo
   - Cream Shampoo
   - Gel Shampoo
   - Aerosol Shampoo
2. Herbal Shampoo
   - Powder Shampoo
   - Dry Herbal Shampoo
   - Herbal Liquid Shampoo
   - Herbal Conditioning Shampoo
3. Medicated Shampoo
   - Anti-dandruff Shampoo
   - Anti-lice Shampoo
   - Anti-fungal Shampoo

Hair loss is a direct result of hair damage caused by the synthetic shampoo. Consequently, herbal shampoos are designed to preserve the texture and health of hair. Herbal shampoo is made with herbal elements like Amla, Aloe vera, Shikakai, hibiscus, Reetha Bhrami, Fenugreek, Bhringraj, Neem. Every ingredient has a certain quality of its own.

Advantages of dry shampoos:

• They can extend the intervals between routine shampoos. This is advantageous because frequent washing can cause your hair to dry out.
• By washing your hair less frequently, you also cut down on the usage of heating tools that might harm your hair, such as curling or straightening irons and hair dryers.
• The volumizing impact of dry shampoos might help you keep your hair groomed for longer.
• Colored hair fades more quickly when wet and shampooed.
• They come in handy whether visiting a hospital or traveling.

MATERIALS AND METHODS

All plant drugs was purchased from Marothiya Bajar Indore. [8]

Fig. No. 1 Neem

Fig. No. 2 Aloe Vera

Fig. No. 3 Shikakai

Fig. No. 4 Hibiscus

Fig. No. 5 Reetha

Fig. No. 6 Amla

Fig. No. 7 Brahmi

Fig. No. 8 Fenugreek

Fig. No. 9 Bhringraj

Table 1. The natural ingredients listed below were used to formulate the herbal dry powder

Plant Profile					
S.No.	**Plant**	**Biological Source and Family**	**Chemical constituent**	**Uses**	**References**
1	Neem	*Azadirachta indica* (Meliaceae)(9)	Azadirachtin, salannin, Meliantriol	Eliminate dandruff, soothe scalp irritation, and treat lice(14)	https://www.healthline.com/health/beauty-skin-care/neem-oil-for-hair
2	Aloe Vera	*Aloe Barbadensis miller* (Liliaceae) (9)	antioxidants, Phenolic acids, Flavonoids, Polysaccharide, Saponins, Alkaloids.	strengthens follicles, reduces dandruff, controls excess oil, and promotes hair growth by stimulating scalp health(15)	https://www.medanta.org/patient-education-blog/how-to-use-aloe-vera-for-skin-and-hair-health
3	Shikakai	*Acacia concinna* (Mimosaceae)	Lupeol, spinasterol, lactone, acacic acid, and the natural sugars arabinose and glucose.	Boosts hair growth, Heals the scalp, **Prevents dandruff on the scalp, It puts a stop to split ends, Treats hair lice,** Itchy scalp treatment, **Hair fall control, Hair follicles protection**(16)	https://www.herbodaya.com/blog/ayurvedas-best-hair-care-remedy-12-benefits-of-shikakai-for-hair-how-to-use.
4	Hibiscus	*Hibiscus rosa-sinensis* (Malvaceae)(10)	Flavanoids, Anthocyanins, Tannins, Vitamins, Mineral	stimulate growth, reduce hair fall, and strengthen follicles(17)	https://www.forestessentialsindia.com/blog/hibiscus-for-hair.html
5	Reetha	*Sapindus mukorossi Gaertn* (Sapindaceae)(11)	Saponins, oleanolic acid, sopindoside A&B, mukuroziosides, and trifolios	controlling dandruff, reducing hair fall, and adding shine(18)	https://smytten.com/blogs/haircare/7-surprising-benefits-of-reetha-for-healthy-lustrous-hair
6	Amla	*Embelica Officinalis* (Euphorbiaceae) (9)	Ellagic Acid, emblicanine A, emblacani, Gallic acid, Phyllatine	promoting growth, strengthening follicles, reducing dandruff, and preventing premature graying(19)	https://www.kamaayurveda.in/blog/Amla-for-Hair-Indian-Secret-to-healthy-lustrous-hair
7	Bhrami	*Bacopa monnieri* (Scrophulariceae) (12)	Bacoside A, Bacoside B, Alkaloids, Saponins, Glycosides	strengthen hair follicles, reduce hair fall, combat dandruff, and promote growth by nourishing the scalp with antioxidants(20)	https://www.nykaa.com/beauty-blog/brahmi-benefits-for-hair
8	Fenugreek	*Trigonella foenum-groecum* (Leguminosae) (13)	Alkaloids, Saponin, Vitamins, Lipids,Carbohydrates	strengthen roots, combat hair fall, and treat dandruff(21)	https://www.healthline.com/nutrition/fenugreek-for-hair
9	Bhringraj	*Eclipta prostrate* (Asteraceae)(9)	Flavonoids, Coumestans, Alkaloids, Triterpenoids, Glycosides, Polyacetylenes, Phenolic acids	promote hair growth, reduce hair fall, combat premature greying, and treat dandruff(22)	https://www.1mg.com/ayurveda/bhringraj-23?wpsrc=Google+Organic+Search

The natural ingredients listed below were used to formulate the herbal dry powder shampoo:

Table 2. Ingredients Table

S.NO.	INGREDIENTS	PART USED	S1	S2	S3
1	NEEM	LEAVE	1g	1g	1.2g
2	ALOEVERA	LEAVE	1g	1g	1g
3	SHIKAKAI	PODS	1g	1g	0.9g
4	REETHA	FRUIT	0.9g	2g	1.1g
5	HIBISCUS	FLOWER	0.9g	1g	1.2g
6	AMLA	FRUIT	0.8g	1g	0.8g
7	BHRAMI	LEAVE	0.7g	1g	0.6g
8	FENUGREEK	SEED	0.7g	1g	0.8g
9	BHRINGRAJ	LEAVE	0.7g	1g	0.8g

Methods of Preparation:

1. Every herbal crude drugs component is dried and ground into a fine powder.
2. A digital balance was used to precisely weigh each of the necessary herbal powders for making dry powder shampoo.
3. Using a mixer, fully combine each of these fine ingredients to create a uniform fine powder.
4. Table 1 lists the herbs, their portion used, and the amount taken.
5. Three shampoo samples (S1, S2, and S3) were made by combining and uniformly powdering.

Fig. No. 10. Sample of powder shampoo (S1, S2&S3)

EVALUATION OF HERBAL POWDER SHAMPOO

Prepared formulations of powder shampoos were subjected to following evaluation parameters like organoleptic property, General powder characteristic, physicochemical evaluation, angle of repose, particle size, bulk density, tapped density etc.

1.Organoleptic property: Organoleptic evaluation can be done by means of organs of sense**.**(23) Color, smell, taste, and texture were all measured. Vision was used to assess color, and touch was used to assess texture.(24) Given in table 3.

2.General powder characteristics: Particle size, angle of repose, bulk density, and tapped density are among the general powder characteristics that are assessed under this area since they will have an impact on the preparation's exterior properties. (25) Sample for all these evaluations were taken at three different level i.e. from top, middle and lower level.

a) Particle size: Mechanical sieve analysis was used to analyze particle size utilizing standard sieves (BSS #60, #80, #100). A mechanical sieve shaker was used to shake a 100g sample for 15 minutes. (26)

Fig. No. 11. Sieve Shaker

b) Angle of repose: The angle of repose represents the steepest angle at which a pile of powder remains stable, forming a clear relationship with the horizontal plane. This measurement is vital for assessing the flow ability and handling properties of powders, making it an essential

consideration in product formulation and processing.(27) The powder's height and radius were measured and noted. One can calculate the angle of repose (θ) using the formula given below,

$$\theta = \tan^{-1}(h / r)$$

Where, θ = Angle of repose, h =height of the heap, r = Radius of the base

Fig. No. 12. Funnel Method

c) Bulk Density: A powder's bulk density is calculated by dividing its mass by the volume it occupies. The mass of powder that can fit into a given volume is another name for it. Both the envelope volumes of the individual particles and the gaps between them are included in the volume.(28) A 50 ml measuring cylinder is filled to the brim with the necessary amount of dried powder. After then, the cylinder is dropped every two seconds from a height of one inch onto a hard wood surface. The powder's volume is measured. The powder is then weighed. The average values are obtained by doing this. The unit of measurement for bulk density is grams per cubic centimeter..(29) The bulk density is computed using the following formula.

$$D = M/V$$

where:

D: is the bulk density in grams per liter (g/l)

M: is the weight of the full container in grams (g)

V: is the container volume in liters (l)

Fig. No. 13. Bulk Density apparatus

d) Tapped density: Tapping the container containing the aerated sample yields the tapped bulk density, also known as random dense packing. While a weak or free-flowing powder has little chance of additional consolidation, the structure of a cohesive powder will collapse dramatically upon tapping.(30) The measuring cylinder or vessel is mechanically tapped for a minute after the initial measurement of the powder's mass or volume, and readings of the mass or volume are obtained until neither quantity changes much more. Grams per cubic centimeter was the unit of measurement.

$$\text{Tapped density (g/ml)} = M / V_f$$

Where, m=mass of the powder in grams, and V_f = final tapped volume in milliliters.

e) Carr's Index: This is calculated using the formula;

$$\text{Carr's indexs} = \frac{\text{Bulk density (Tapped)} - \text{Bulk density (Untapped)}}{\text{Bulk density (Tapped)}} \times 100$$

f) Hausner's Ratio: One metric for assessing a powder's flowability is the Hausner ratio. It is computed by dividing a powder's bulk density by its tapped density. [7,15]

$$\text{Hausner Ratio} = \frac{\text{Tapped Density}}{\text{Bulk Density}}$$

Sr.no.	Carr's index	Flow Property	Hausner Ratio
1.	<10	Excellent	1.00-1.11
2.	11-15	Good	1.12-1.18
3.	16-20	Fair	1.19-1.25
4.	21-25	Passable	1.26-1.34
5.	26-31	Poor	1.35-1.45
6.	32-37	Very Poor	1.46-1.59
7.	>38	Very very poor	>1.60

Table3: Represents the relationship between Carr's index, Hausner ratio and flowability.

PHYSICOCHEMICAL EVALUATION

a) Foaming ability and foam stability: A 50 ml measuring cylinder containing 50 ml of a 1 weight percent shampoo solution was used to measure foamability. After that, the cylinder's contents were manually shaken for 30 seconds while the intake was securely covered. The height of the resultant foam was measured shortly after the shaking procedure, accounting solely for the dense, stable foam layer. The measurements were taken five, ten, and fifteen minutes after the shaking was finished.(31)

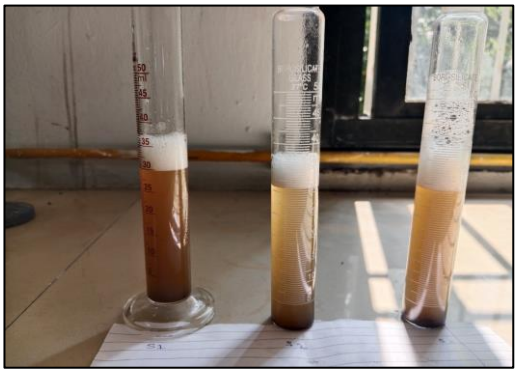

Fig. No. 14. Represents foaming ability of powder shampoo

b) pH determination: PH of your shampoo solution at 10%. One pH paper strip should be dipped in the solution, and its color should be compared to the key. After calibration, pH meters can also be utilized.

The majority of shampoos are either neutral or mildly acidic. Acidic solutions give the appearance of smoother hair. Simple fixes provide the appearance of frizz.(32)

Acidic pH < 7 , Basic pH > 7 , Neutral pH = 7

Fig. No. 15. Shows pH of S1, S2 & S3

c) Skin Irritation Test: After applying the necessary quantity of the herbal powder shampoo to the skin, any discomfort or inflammation is noted. Tests for skin irritation have revealed that herbal shampoo powder has no negative effects on the skin or eyes.(33) This is due to the fact that herbal shampoos are composed of natural components rather than

artificial surfactants, which can irritate the cornea and cause inflammation. Herbal shampoos are devoid of harsh chemicals and contain extracts of natural substances. Compared to synthetic shampoos, which may include hazardous chemicals, they are thought to be safer and more environmentally friendly.(34)

d) Washability: After the formulations were applied to the skin, the degree and ease of water washing were manually evaluated.

e**) Solubility:** A substance's solubility is its capacity to dissolve in a solvent. A beaker containing 100 ml of water is filled with precisely weighed 1g of the powder. This was carefully stirred and heated to increase the solubility. The residue is measured and noted upon cooling and filtration.(35)

f**) Stability Study:** The stability and acceptability of the formulations' organoleptic characteristics (colour and odor) throughout storage served as evidence of their chemical and physical stability. (36)

RESULT AND DISCUSSION

Table: 4 Shows Organoleptic Property

Sr.no.	Test	Observation
1.	Colour	Brownish
2.	Taste	Slight
3.	Texture	Fine & Smooth
4.	Odour	Characteristic

Table 5: General powder characteristics

Sr.no.	Evaluation Test	Results		
		S1	S2	S3
1.	Particle size	20-23nm	20-23nm	20-23nm
2.	Angle of Repose	42.53 °	45°	47.73°
3.	Bulk density	0.5g/cm^3	0.4g/cm^3	0.28g/cm^3
4.	Tapped density	0.67g/cm^3	0.625g/cm^3	0.588g/cm^3
5.	Carr's index	25.37%	36%	51%
6.	Hausner's ratio	1.34	1.48	2.0

Table 6: Physicochemical properties

Sr. no.	Test	Results		
		S1	S2	S3
1.	Foaming capacity (%)	151.5	150.2	149.8
2.	pH determination	5	6	5
3.	Skin irritation test	No harmful effect on skin	No harmful effect on skin	No harmful effect on skin
4.	Washability	Easily washable	Easily washable	Easily washable
5.	Solubility	Insoluble in water	Insoluble in water	Insoluble in water
6.	Stability study	Stable	Stable	Stable

Herbal powder shampoo was prepared using Amla powder, Reetha powder, Shikakai powder, Bhringraj Powder, Fenugreek powder, Hibiscus powder, Neem leaf powder, Aloe Vera powder, Brahmi powder was used in the formulation of the preparation. (Table 1) These formulas were made by continuously triturating and combining in ascending order by weight. This product was assessed organoleptically by looking at its color, texture, taste, and odor. According to the results, the color is brownish (Table

4). The formulation's general powder properties were completed and are displayed in (Table 5). The formulation's physicochemical evaluation was completed and is displayed in (Table 6).

CONCLUSION

Most people believe that shiny hair with a smooth texture and neatly clipped ends is healthy. Customers have been demanding more hair care products in recent years, particularly natural products. As a result, this study concentrates on hair care products that are used in cosmetics and emphasizes the value of herbal dry powder shampoo. Components of the formulation include Amla powder, Reetha powder, Shikakai powder, Bhringraj powder, Fenugreek powder, Hibiscus powder, Neem leaf powder, Aloe Vera powder, and Brahmi powder. A number of quality control criteria were examined. Every parameter yields a positive outcome. According to the current study's findings, shampoo containing these medications' active components produces more stable goods with improved visual appeal. Stabilizing the ecological balance of the scalp, reducing eye discomfort, and increasing and enhancing the attributes of hair have all been demonstrated to be influenced by the shampoo's ph. The current trend of promoting shampoos with a lower pH is one way to minimize hair damage. A formulation's estimated results are used to demonstrate the product's good performance and strong utilization. The evaluation parameters, which included the following: cleaning action, foaming, general powder characteristics, physicochemical evaluation, organoleptic evaluation, and nature of hair after washing, were conducted and were found to be within the standard range.

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Authors' contributions

The author agreed to take full responsibility for all elements of this study and contributed to the data analysis, drafting, and revision of the publication.

Declaration of Conflicts of Interests

The author states that they have no competing interests.

Ethics approval and consent to participate

Not applicable because neither humans nor animals were included in the experiment.

Availability of data and materials

Not Applicable

Use of Artificial Intelligence

Not applicable

Declarations

The authors affirm that this material has not been published in any other journal and that all of the work is original.

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