

Formulation, evaluation and characterization of powder herbal shampoo

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Abstract

The present study was planned to formulate and evaluate powder herbal shampoo comprising poly herbs viz., *Azadirachta indica*, *Embelica officinalis*, *Trigonella Foenumgraecum*, *Acacia concinna*, *Centella asiatica*, *Aloe barbadensis*, *Hibiscus rosea* and *Rosa rubiginosa*. The powder herbal shampoo was prepared by homogeneous mixing of powdered form of herbs under the study using cyclone blender at optimum speed. The prepared powdered shampoo were evaluated for visual inspection, texture, particle size, packability, flowability, pH, washability, dirt dispersion, moisture content, foaming index and wetting time. All the trial powdered shampoos were free flowing, homogeneous in particle size, has good packability and better flowing property. The characterization studies suggest that shampoos has desired pH, washable, good detergency property, desired foaming index. However, further research development is required to improve its quality and safety.

Keywords: Herbal shampoo; Evaluation; Foaming index; Dirt dispersion; Wetting time

1. Introduction

The word cosmetics derives from the Greek words "*kosmetike tekhnē*", meaning technique of dress and ornament, giving "*kosme tikos*" meaning having the power arrange, skilled in decorating, ordering, giving *kosmein*, to adorn and that from "*kosmos*", meaning order, harmony and ornament. The Drugs and Cosmetic Act 1940 and Rules 1945 defines Cosmetics as any article, preparation, product intended to be rubbed, poured, sprinkled or sprayed on, or introduced into or otherwise applied to the human body or any part thereof for cleaning, beautifying, promoting attractiveness, or altering the appearance. The cosmetics are the preparations can be placed in contact with the various parts of the human body (epidermis, hair system, nails, lips, and external genital organs) or with the teeth and the mucous membranes of the oral cavity with a view to exclusively or mainly to cleaning them, perfuming them, or changing their appearances and/or correcting body odours and/or protecting them or keeping them in good condition¹⁻³.

Herbal cosmetics are the products or preparations that use plant based ingredients viz., powders, crude herbs, extracts, essential oils etc., with a standard cosmetic base for cleaning, beautifying, promoting attractiveness, or altering the appearance. Herbal cosmetics mainly addressing face, body and hair with their unique properties viz., moisturizing, cleansing, conditioning, antiinflammatory, antioxidant and other properties. Cosmetic preparations addressing to the hair care includes hair creams, hair gels, hair lotions, shampoos. Shampoos are probably the most widely used cosmetic products for cleansing hairs and scalp in our daily life⁴.

A shampoo is basically a solution of a detergent containing suitable additives for other benefits such as hair conditioning enhancement, lubrication, medication etc. Now-a-days many synthetic, herbal, medicated and non medicated shampoos are available in the market but popularity of herbal shampoo among consumers is on rise because of their belief that

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these products being of natural origin are safe and free from side effects^{5,6}. Synthetic surfactants are added to shampoo primarily for the foaming and cleansing action but their regular use leads to dryness of hairs, hair loss, irritation to scalp and eyes⁷ herbal shampoos are considered as alternative to synthetic shampoo⁸.

Herbal shampoo is a hair cleansing cosmetic preparation made primarily from natural ingredients derived from plants for various clinical purposes viz., moisturizing, antibacterial, cleanizing, antidandruff and conditioning. The herbal shampoos can be formulated in various forms viz., liquid shampoos, gel shampoos and powder shampoo. The present work was aimed to formulate, evaluate and characterize the powder herbal shampoo comprising *Azadiracthta indica* (Neem leaves), *Embelica officinalis* (Amla fruits), *Trigonella Foenumgraecum* (Fenugreek seeds), *Acacia concinna* (Shikakai fruits), *Centella asiatica* (Brahmi dried leaves), *Aloe barbadensis* (Aloe vera leaves), *Hibiscus rosea* (Hibiscus flowers) and *Rosa rubiginosa* (Rose petals).

2. Materials and Methods

2.1. Collection of Plant materials

The plant materials necessary for powder herbal shampoo viz., Neem leaves, Amla fruits, Fenugreek seeds, Shikakai fruits, Brahmi dried herb, Aloe vera leaves, Hibiscus flowers and Rose petals were collected in and around of Tirupati figure 1.

2.2. Authentication of the plant materials

The collected plant materials authenticated to ensure the plant parts and used as genuine materials for preparation. The major methods employed in the authentication of herbal materials are macroscopic (colour, odour, taste etc.), microscopic examination (qualitative and quantitative microscopical characters) and chemical identification tests.

2.3. Preparation of plant materials

The collected plants materials were initially shade dried for specific period as per standard methods. The dried plant materials were powdered in suitable blenders and passes through #100 mesh to achieve uniform particle size. The sieved homogeneous powders were stored in air tight containers for further use.

2.4. Preparation of powder herbal shampoo

The selected powdered plant materials were accurately weighed as per the table 1 and were mixed by adapting geometric dilution method in a cyclone blender for 30 min to achieve homogeneous product. The obtained powder herbal shampoo was allowed to pass through # 100 and packed in an air tight container for further evaluation.

		
<i>Azadiracthta indica</i>	<i>Embelica officinalis</i>	<i>Trigonella Foenumgraecum</i>

**Figure 1** Herbal plant materials selected for powder herbal shampoo**Table 1** Formulae of powder herbal shampoo

Powdered plant Material (G)	Batches (20 G)			
	F-1	F-2	F-3	F-4
<i>Azadiracthta indica</i>	2.8	2.4	2.6	2.2
<i>Embelica officinalis</i>	2.4	2.2	2.8	2.4
<i>Trigonella Foenumgraecum</i>	2.4	2.2	2.8	2.0
<i>Acacia concinna</i>	4.8	5.0	4.8	5.0
<i>Centella asiatica</i>	3.2	3.4	3.6	3.4
<i>Aloe barbadensis</i>	1.8	1.6	1.4	1.8
<i>Hibiscus rosea</i>	1.6	1.8	1.2	1.4
<i>Rosa rubiginosa</i>	1.0	1.4	0.8	1.8
Total weight (G))	20	20	20	20

3. Evaluation of powder herbal shampoo

3.1. Organoleptic and morphological studies^{9,10}

All powder shampoo formulations were subjected for organoleptic evaluation parameters viz., Colour, odour and taste. Further they evaluated for their appearance, texture and smoothness.

3.2. Powder properties^{11,12}

All powder shampoo formulations were subjected for particle size determination, bulk density and angle of repose using standard procedures.

3.2.1. Particle size

The microscopic method was used to determine the particle size. During the study the microscope was calibrated using stage micrometer and eyepiece micrometer by standard procedure. After calibration about 300 particles were counted and particle size is determined by using appropriate equation.

3.2.2. Bulk density (ρ_b)¹³

A sample of about 25 cm³ of powder shampoo (F-1 to F4) that has previously been passed through a U. S. Standard sieve is carefully introduced into a 25 ml graduated cylinder. The cylinder is dropped at 2 sec intervals onto a hard wood surface 3 times from a height of 1in. The bulk density is then obtained by dividing the weight of the sample in grams by the final volume in cm³ of the sample contained in the cylinder.

$$\rho_b = \frac{M}{V_o}$$

ρ_b - Bulk density (cm³); M- Weight of powder (gm); V_o - bulk volume (cm³)

3.2.3. Angle of repose (θ)^{14,15}

Fixed funnel method was used for study in each case of powder shampoo (F-1 to F-4) a funnel was fixed with its tip at a given height (h), above a flat horizontal surface on which a graph paper was placed. Powder shampoo was carefully poured through a funnel till the apex of the conical pile just touches the tip of funnel. The angle of repose (θ) was calculated by following equation,

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

Where, θ = Angle of repose; h = Height of pile; r = Radius of the base of the pile

3.3. Moisture content¹⁶

In a tarred evaporating dish, 5G of powder herbal shampoo formulations (F-1 to F-4) were maintained at 105° C in a hot air oven. Until a steady weight was achieved, the weight loss was noted every fifteen minutes.

3.4. pH

During study 1 G of powder herbal shampoo was dispersed in 10 ml of distilled water and pH was measured using digital pH meter.

3.5. Cleanizing action¹⁷

1 G of powder herbal shampoo was dispersed in 200 ml of distilled water. Immerse grease saturated 2G of wool into shampoo dispersion for 5 min, extract the wool dried and weighed, determine the amount of grease removed from wool.

3.6. Foaming capacity^{18,19}

In each case of powder herbal shampoo (F-1 to F-4) foaming capacity was determined by shaking 1G of powder shampoo with 50 ml of distilled water in 250 ml graduated measuring cylinder for 10 min interval for 60 min. In each time interval % foaming capacity was calculated.

3.7. Dirt dispersion²⁰

10 ml of distilled water were placed in a big test tube, and two drops of each of the 1% powder herbal shampoo formulations (F-1 to F-4) were added. After adding a drop of Indian ink, the test tubes were shaken and sealed. It was judged that there was none, moderate, or substantial ink in the foam.

3.8. Wetting time²¹

A canvas was taken and cut into 1 inch diameter discs. The discs were floated on the surface of each formulation (F-1 to F-4) of 1% powder herbal shampoo solution and time was noted. The time required for the disc to begin sink was measured accurately and noted as wetting time.

4. Result and Discussion

4.1. Organoleptic and Morphological properties

The organoleptic and morphological data was given in table 2. The powder herbal shampoos viz., F-1 to F-4 were found to be fine powder with smooth texture without any gritty particles. The colour, odour and taste were measured and the results indicate a noticeable Hue shift to some extent.

Table 2 Organoleptic and Morphological data of F-1 to F-4 powder herbal shampoo

Powder Herbal Shampoo	Appearance	Colour	Odour	Taste	Texture
F-1	Amorphous	Pale Brown	Characteristic	Acrid	Fine and Smooth without any gritty particles
F-2	Amorphous	Faint Brown	Characteristic	Acrid	Fine and Smooth without any gritty particles
F-3	Amorphous	Pale Brown	Characteristic	Acrid	Fine and Smooth without any gritty particles
F-4	Amorphous	Pale Brown	Characteristic	Acrid	Fine and Smooth without any gritty particles

4.2. Powder characteristics

The particle size, bulk density and angle of repose data of powder herbal shampoos viz., F-1 to F-4 was given in table 3 and comparative data. The data was found to be in the range of 3.12 μm to 4.12 μm for particle size; 0.334 to 0.412 gm/cc for bulk density and 30⁰62¹ to 33⁰57¹. The outcome of the results were within the acceptable limit under assessment criteria.

Table 3 Powder characteristic data of F-1 to F-4 powder herbal shampoo

Powder Herbal Shampoo	Particle size μm	Bulk density gm/cc	Angle of repose θ
F-1	3.43	0.346	31 ⁰ 22 ¹
F-2	4.12	0.412	33 ⁰ 57 ¹
F-3	3.12	0.334	30 ⁰ 62 ¹
F-4	3.53	0.356	31 ⁰ 43 ¹

4.3. Moisture content

The % moisture content (table 4) of powder herbal shampoos viz., F-1 to F-4 was 0.85 to 1.01%, suggest they were dried and stable for storage and usage.

4.4. Determination of pH

The pH of powder herbal shampoos viz., F-1 to F-4 found in the range of 5.5 to 5.6 (table 4) indicate all formulations showed slightly acidic pH, which may not cause damage to the hairs and skin.

Table 4 Characteristic evaluation data of F-1 to F-4 powder herbal shampoo

Powder Herbal Shampoo	% Moisture content	pH	Cleanizing action	% Foaming capacity	Wetting time sec
F-1	0.95	5.5	93.45	135	120
F-2	0.91	5.6	95.34	134	132
F-3	0.85	5.6	96.12	142	128
F-4	1.01	5.6	94.56	135	136

4.5. Cleanizing action

Since a shampoo powder's main function is cleaning, the cleaning action of wool in grease was evaluated (table 4). The results show that the powder herbal shampoos viz., F-1 to F-4 differed significantly in how much grease they were able to remove. Among the F-1 to F-4 formulations F-3 demonstrated superior grease removal capabilities.

4.6. Foaming capacity

The foaming capacity was good in all four powder herbal formulation and there is no significant difference in the % Foaming index as given in table 4. In distilled water, the foaming properties of F-1 to F-4 powder herbal shampoo were 134 to 142% over 60 min period. After one minute of shaking, the total volume of foam from the herbal shampoo powders ranged from mild to good.

4.7. Wetting time

A substance's wetting time depends on its concentration. The wetting time of F-1 to F-4 powder herbal shampoo were noted (table 4). In contrast to the other three formulations, the F-1 formulation had a shorter wetting time.

4.8. Dirt dispersion

Powder herbal shampoo are regarded as being of low quality if they concentrate the ink in the foam. It will be challenging to rinse away any filth that remains in the foam. The amount of ink in the foam of the F-1 to F-4 powder herbal shampoo were assessed. It was discovered that it varied from light to moderate.

4.9. Washability

The F-1 to F-4 powder herbal shampoo were easily washable, soft and manageable.

5. Conclusion

The poly herbal powder shampoos viz., F-1 to F-4 comprising different concentrations of *Azadiracthta indica* (Neem leaves), *Embelica officinalis* (Amla fruits), *Trigonella Foenumgraecum* (Fenugreek seeds), *Acacia concinna* (Shikakai fruits), *Centella asiatica* (Brahmi dried leaves), *Aloe barbadensis* (Aloe Vera leaves), *Hibiscus rosea* (Hibiscus flowers) and *Rosa rubiginosa* (Rose petals) were successfully prepared, evaluated and characterized. The results concludes that the herbs used in the formulation shows good and better cleanizing and conditioning properties on the hair. The powder herbal shampoos were fine and smooth texture and foaming capacity was better with light to moderate dirt dispersion, slightly acidic pH concludes no harm to the hair and skin. Over all study concludes that all four powder herbal shampoos shows significant properties and can be subjected for scale up studies.

Compliance with ethical standards

Disclosure of conflict of interest

There are no conflicts of interest. Authors have declared that no competing interests exist.

Disclaimer (Artificial Intelligence)

We hereby declared that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Author's contribution

The collaborative efforts of all authors have successfully led to study of formulation, evaluation and characterization of powder herbal shampoos. K Gunasekher, C Mahendra, J Madhavi, P Sushmitha, A Likhitha under the mentorship of Dr Lakshmayya Professor and Director Seven Hills College of Pharmacy (Autonomous) Venkatramapuram, Tirupati conducted the research study. Dr Y Anand Kumar Professor and Head V L College of Pharmacy, Raichur provided guidance in crafting the manuscript and structuring the research paper in accordance with the journal's guidelines.

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