Pharmaceutical Evaluation and Comparison of Popular Herbal Shampoo Brands with Synthetic Shampoo Brands of India

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ABSTRACT
The most popular type of hair care is shampooing. Shampoos are basically hair and scalp washing agents. There are numerous shampoo brands on the market that cater to various hair issues. One such categorization is herbal and synthetic shampoos where former claim to be prepared from natural ingredients and more safer for human use while latter are prepared entirely from range of synthetic chemicals/compounds and sometimes assumed to show allergic reaction or side effects on hair and scalp in long run usage. This study intends to assess specific shampoos based on their physicochemical characteristics, pH measurement, percentage of solid content, cleansing performance, dirt dispersion, foaming ability and foam persistence, and skin irritancy. These parameters were selected to cover evaluation of visual appearance, efficacy as well as safety issues related to herbal and synthetic class and how far they justify their claims. Six shampoo brands from each category i.e. Patanjali’s Keshkanti, Vatika, Chik hair solutions from herbal category and Clinic Plus, Dove, Sunsilk from synthetic category were procured from market and evaluated for above said tests. All shampoos were found to perform well in most tests with some surpassing others in one or another factor with mild variation. But since none particular test be considered more important than other hence giving a composite score to shampoos based on all tests is impossible. Overall, all shampoos of both categories were found to contain each ingredient within specified limit and none showed skin irritancy hence could be considered safe.

Keywords: Herbal shampoo, Synthetic shampoo, Dirt dispersion, pH measurement, percentage of solid

1. INTRODUCTION
Hair is derived from ectoderm layer of skin serves as protective appendage and external barometer for internal body conditions. The skin on our head produces a greasy fluid called Sebum. This gives the hair a healthy shine but when secreted in large amount it makes the hair look dirty.[1] To eradicate it cleansing agent i.e. hair shampoo is used which is basically a surfactant in liquid, solid or powder form. The goal of using shampoo is to remove surface grease, dirt, dandruff, excess sebum and skin debris from the hair shaft and scalp without adversely affecting the user. Henceforth, a wide range of hair shampoo addressing different hair concerns and issues are marketed such as improving hair quality, texture, treatment of oily hairs, dandruff and for androgenic alopecia.[2] Figure 1 below shows classification of hair Shampoos on various grounds.

![Fig. 1: Classification of hair shampoo](image)

Herbal shampoo: A cosmetic cleansing preparation/decoction of traditional ayurvedic herbs prepared via traditional ayurvedic methods and free from harmful surfactant [SLS], synthetic additives and petroleum based ingredients.[4] Some of the
famous marketed brands of herbal shampoo includes Patanjali Coconut Hair Wash, Indulekha Bringha anti fall shampoo, Biotique Bio Green Apple Fresh Daily Purifying Shampoo and Conditioner, Khadi Herbal Saffron, Tulsi and Reetha Shampoo, Ayur Herbal Shampoo Amla, Shikkakai With Reetha. Refer Table 1 for various ingredients list used in herbal shampoo formulation.

Table 1: List of herbal plants and their parts used in herbal shampoo

<table>
<thead>
<tr>
<th>Plant species</th>
<th>Family</th>
<th>Common Name</th>
<th>Plant part</th>
<th>Purpose of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piper betle</td>
<td>Piperaceae</td>
<td>Betel, pan</td>
<td>leaf</td>
<td>Promotes hair growth, anti dandruff, relieves scalp itchiness</td>
</tr>
<tr>
<td>Hibiscus Rosa sinensis</td>
<td>Malvaceae</td>
<td>Chinese Hibiscus, shoe black plant</td>
<td>flower</td>
<td>Anti hairfall, prevent premature graying, anti dandruff, conditioning of hair</td>
</tr>
<tr>
<td>Lawsonia inermis</td>
<td>Lythraceae</td>
<td>Heena, mehndi</td>
<td>leaf</td>
<td>Build protective layer around hair cuticle and avoids hair damage, also used for colouring hair</td>
</tr>
<tr>
<td>Datura metal</td>
<td>Solanaceae</td>
<td>Thorn-apple, devil’s trumpet</td>
<td>fruit</td>
<td>Promotes hair growth by improving circulation in scalp and hair follicles</td>
</tr>
<tr>
<td>Magnifera indica</td>
<td>Anacardaceae</td>
<td>Mango, aam</td>
<td>kernel</td>
<td>Anti dandruff, promotes hair growth by improving circulation in scalp and hair follicles</td>
</tr>
<tr>
<td>Nyctanthes arbor-tristis</td>
<td>Oleaceae</td>
<td>Coral Jasmine, har-shringar</td>
<td>seeds</td>
<td>As cleansing agent and to control dandruff</td>
</tr>
<tr>
<td>Camellia sinensis</td>
<td>Theaceae</td>
<td>Tea plant, Tea tree oil</td>
<td>leaf</td>
<td>Gives reddish color to hair shaft also as conditioner to hair</td>
</tr>
</tbody>
</table>

Synthetic Shampoo: A viscous cosmetic preparation with synthetic detergent used to clean the scalp.[6] Some of the famous marketed brands of synthetic shampoo includes Dove, L'oreal Paris, Pantene, Head & Shoulders, Tresemme, Park Avenue, Garnier Ultra Doux shampoo. Refer Table 2 for list of various ingredients of synthetic shampoos.

Table 2: List of common ingredients of synthetic shampoo along with their uses

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Examples</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surfactants</td>
<td>[a] Anionic Surfactants</td>
<td>Alkyl sulphates, Alkyl ether sulphate</td>
</tr>
<tr>
<td>Surfactants</td>
<td>[b] Non-ionic Surfactants</td>
<td>Alkanolamides</td>
</tr>
<tr>
<td>Surfactants</td>
<td>[c] Cationic Surfactants</td>
<td>Alkyl amines, alkyl imidazolines</td>
</tr>
<tr>
<td>Surfactants</td>
<td>[d] Amphoteric Surfactants</td>
<td>Acyl amino acids</td>
</tr>
<tr>
<td>Foam booster</td>
<td>Monoethanolamides, lauramides</td>
<td>Foaming agent</td>
</tr>
</tbody>
</table>
Germicide and anti-dandruff

Banzalkoniumchloride, cadmium sulphide

Prevent the growth of micro-organism

Antibacterial agent

Triclosan

Prevents bacterial growth

Conditioning agent

Lanolin, egg, amino acids

Make hair lustrous

Pearlescent agent

4-methyl-7-diethylamino coumarin, 4-methyl-5,7-dihyrdocoumarin

Imparts brightness to hair.

Sequestrants

EDTA, citric acid, tripohyphosphate

Complex forming agents.

Thickeners

Alginates, polyvinyl alcohol, methyl cellulose, polyethylene glycol

Make preparation thick [viscous]

Perfuming agent

Herbal fruits or floral fragrance

Imparts good fragrance

Colour

FD and C dye

Gives pleasant appearance to the preparation.

Preservatives

Parabens, formaldehyde

Increases its shelf life

Protective agent

Dimethicone

Prevents hair and scalp damage

Table 3: List of selected synthetic and herbal shampoos for study

<table>
<thead>
<tr>
<th>SYNTETIC SHAMPOOS</th>
<th>HERBAL SHAMPOOS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brand</strong></td>
<td><strong>Batch No.</strong></td>
</tr>
<tr>
<td>Clinic plus strong &amp; long health shampoo</td>
<td>8HUC189</td>
</tr>
<tr>
<td>Dove Nutritive Solution</td>
<td>7HUD0089</td>
</tr>
<tr>
<td>Sunsilk</td>
<td>B011</td>
</tr>
</tbody>
</table>

**Kesh Kanti Natural cleanser**

Kesh Kanti Natural cleanser | P189 | 06/2021 | 05/2023 | Patanjali Ayurvedic Ltd. |

**Vatika Premium Natural [beena & olive] Shampoo**

Vatika Premium Natural [beena & olive] Shampoo | 7RV0089 | 10/2021 | 09/2023 | Dabur India Ltd. |

**Chik Protein Solutions**

Chik Protein Solutions | 5CK041 | 5/2021 | 04/2023 | Calvinkare Pvt. Ltd. |

**Materials and Methods**

**Specimen Collection:** For the current study different marketed synthetic and herbal shampoos were procured from reputed general stores in Sonipat selling genuine brands. List of selected shampoos for evaluative study in Table 3 below:

**Evaluation of collected specimens:**

Several quality control tests and various parameters such as visual evaluation and physicochemical controls conditioning performance, were used to assess the quality of procured synthetic and herbal formulations.

**Visual Inspection:** Among physical appearance the parameters covered include colour, clarity, texture, odour and foam producing ability [7].

**Determination of pH:** At room temperature, the pH of a 10% v/v shampoo solution in distilled water was determined using a pH meter. 10% v/v solution was prepared by mixing 10 ml of shampoo
with 100 ml of distilled water by gentle swirling action and not by shaking.[8]

The majority of shampoos are neutral or barely acidic. The cuticle of the hair contracts and flattens down when exposed to acidic liquids while it swells and opens up in response to basic formulations. While basic preparation are responsible for making hair frizzier, acidic preparation leads to smoother hair.

**Dirt Dispersion Test:** 2 drops of each marketed shampoo were taken separately in test tubes and distilled water was added to each to raise the volume to 10 ml. Ink was then added, stopcork fitted to each tube and was shaken 10 times. The quantity of ink in the foam was reported on scale of none, light, moderate and heavy.[9] Poor-quality shampoos result in collection of ink in the foam. Ideally, the water layer should hold the dirt. It will be challenging to rinse out any dirt that is still in the foam, and it will end up being redeposited on the hair.

**Wetting Time:** Drave’s method was used for evaluation of wetting ability. Canvas with some weight was cut into 3.5cm diameter disc and averagely weighing 0.34g. It was floated on the surface of shampoo solution [1% w/v] and stop watch was started. The time required for disc to begin to sink was measured accurately and noted as wetting time. The wetting efficiency increases with decreasing sinking time.[10]

**Foam Volume, Quality and Retention Test:** A measuring cylinder with a stopcork was filled with approximately 10ml of shampoo solution, and it was shaken for 10 seconds. Foam volume was determined immediately using below formula:

\[
\text{Foam Volume} = \frac{\text{final volume of shampoo} - \text{initial volume}}{\text{initial volume}}
\]

Foam quality as well as retention test was initiated as soon after, three minutes later, and six minutes later.[11]

**Skin Irritancy Test:** Human volunteers were employed for the skin sensitization/irritation test, which determines if it causes skin irritation or not.

**Determination of Percentage of Solid Test:** After weighing an clean and dry evaporating dish, 4 gm of shampoo was added to each dish separately and labelled. It was placed on the hot plate until the liquid part gets evaporated. After drying, the weight of the shampoo's solid components was determined.[12] The following formula was used to get the percentage of solids:

\[
\% \text{ solid} = \frac{\text{dried wt of shampoo}}{\text{initial wt of shampoo}} \times 100
\]

It will be challenging to massage a shampoo into hair or wash it out if it contains an excessive amount of solids. It will be overly liquid and dissolve too quickly if there aren't enough solids in it. Solids make up 20–30% of a decent shampoo.

**Cleansing Ability Test:** In a petri dish with 20ml of water and 2g of shampoo was placed human volunteer's oil-soaked hair. The water's temperature was kept at 35°C. The hairs were shook 50 times per minute for four minutes at a time. The sample was taken out of the solution, dried, and weighed. The grease removed was computed using the following equation:

\[
\% \text{ Detergent Powder} = 100 \left(1 - \frac{\text{Wt of hair without sebum}}{\text{Wt of hair with sebum}}\right)
\]

**RESULTS AND DISCUSSION**

On the basis of all parameters and tests mentioned above, results of comparative visual appearance of synthetic and herbal shampoo formulations are compiled in the table 4 below:

<table>
<thead>
<tr>
<th>Sr. no.</th>
<th>Brand</th>
<th>Category</th>
<th>Physical appearance/visual inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Colour</td>
</tr>
<tr>
<td>1.</td>
<td>Keshkanti</td>
<td>Natural Hair</td>
<td>Pale yellow</td>
</tr>
</tbody>
</table>

Table 4: Result of Visual Appearance tests conducted for synthetic and herbal shampoos under study
**Fig. 2:** pH measurement observations along with graphical plot for different pH of brands

**Dirt Dispersion:** Shampoo that concentrates ink in the foam was seen as being of low quality. Foam would make it difficult to rinse off and would cause the dirt to reappear on the hair, thus the dirt should stay in the water. Since the ink is not concentrated in the foam, all of the formulations with the exception of Keshkanti and Chik were found to be of high quality [refer figure 3].

**Fig. 3:** Dirt dispersion observations of different herbal and synthetic brands under study

**Wetting Time:** All of the formulations' wetting times were determined to be between 2 and 10 seconds. Wetting ability increased when wetting time was decreased. In contrast to Vatika, which has little wetting power, Keshkanti and Dove have strong wetting powers. Since wetting time tells about efficacy of surfactant, it can be concluded the one with least wetting time has highest amount of detergents [i.e. Keshkanti and Dove] while the one with maximum wetting time has
least concentration of detergents [i.e. Vatika], refer figure 4.

Fig. 4: Wetting time observations for different herbal and synthetic brands under study

**Foam Volume, Quality and Retention Test:**

Foam volume produced by a shampoo should be stable and should remain at least for 5 minutes lesser than this may cause consumer dissatisfaction. A test on foam volume revealed that more foam produced results in more dirt being removed, proving that Clinic Plus has effective dirt removal capabilities [refer figure 5].

Fig. 5: Foam Volume and Retention observations for herbal and synthetic brands

**Skin Irritancy Test:** A test for skin irritation revealed that no formulation causes skin irritation. There is no irritation, erythema or oedema formation. Hence the skin irritation potential due to various chemical/herbal substances used is nullified and all brands have used chemicals within the safer range for human application. Refer figure 6 for observations.

Fig. 6: Skin irritancy test for different herbal and synthetic brands under study

**Percentage of Solid:** Good shampoos typically contain 20% to 30% solids since they can be applied and rinsed from the hair with ease. If it lacks sufficient solids, it will be overly watery and rapidly wash away. Similar to this, too many solids will be difficult to wash out or work into the hair. All of the shampoos that were put to the test had solid ingredients that ranged from 22 to 29 percent, and they should all be easily removable [refer figure 7 for observations].
Cleansing Ability: All formulas underwent testing for cleaning ability, and all tests showed that cleaning ability was good if it removed oil, sebum, and grime from hair with ease. Clinic Plus therefore offers effective cleansing properties [refer figure 8 for observations].

Below in Table 5, we have provided summarized result of various test parameters and the values obtained for different brands.

Table 5: Result of other parameters and tests conducted for synthetic and herbal shampoos

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Keshkanti Natural Hair</td>
<td>Herbal</td>
<td>7.15</td>
<td>moderate</td>
<td>2 second</td>
<td>At 0 min 11</td>
<td>At 3 min 0.5</td>
<td>No irritation</td>
<td>22 %</td>
</tr>
<tr>
<td>2</td>
<td>Vatika Premium Natural</td>
<td>Herbal</td>
<td>7.85</td>
<td>Light foam</td>
<td>10 second</td>
<td>At 0 min 12</td>
<td>At 3 min 1.9</td>
<td>No irritation</td>
<td>20 %</td>
</tr>
</tbody>
</table>
CONCLUSION
Any cosmetic product must be carefully formulated using natural ingredients and raw materials. Selecting a natural material that can be rationally justified and is similar to synthetic material presents the biggest obstacle. Our goal in the current study is to detect how far herbal shampoo serve the cleansing purpose equivalent to synthetic shampoos and also how safer they are in comparison to them.

Since none of the tested shampoo formulations performed better than the others in all of the tests, it is difficult to say which shampoo is the best. Due to the fact that each test is significant in its own right, it is also challenging to order the tests according to importance. Although some of the characteristics were outside the normal range for some shampoos, it was found that many of these shampoos' properties fell within the norm. Since all of the shampoos that were evaluated had comparable outcomes throughout all of the tests, it is obvious that they can all be substituted for one another. Further study is needed to examine these brands' rheological assessments, toxicity studies, and tests for ocular irritation and microbiology.

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