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Formulation, Evaluation, and Comparison of Poly Herbal Shampoo with the Commercial Herbal Shampoos

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ABSTRACT: The study aimed to formulate a pure herbal shampoo and to evaluate and compare its physicochemical properties with two marketed herbal shampoos. The herbal shampoo was formulated by mixing the extract of Wild mussaenda(Mussaenda frondosa) and Reetha (Sapindus mukorossi) along with gel of aloe leaves (Aloe vera), juice of lemon fruits (Citrus limon), and oil of mentha leaves (Mentha piperita) solution of gum tragacanth (Astragalus gummifer) and oil of castor seeds (Ricinus communis) in various proportions to Gelatin solution of 10%. We have evaluated the formulation, and compared it with marketed herbal shampoos. We have used the Physico chemical approach to preservation and by formulating a self preserving shampoo, have avoided this risk posed by chemical preservatives. However, the aesthetic attributes, such as lather and clarity, of the laboratory shampoo are not comparable with the marketed shampoo. The foam volume was on a par. It is very important to know and understand effects of ingredients used in shampoo formulations. In the present study the marketed herbal shampoos based on synthetic ingredients and herbal ingredients are compared for their effectiveness and safety with the formulated shampoo.

I. INTRODUCTION:

Cosmetics have become part of our routine and are widely used to enhance appearance. The importance of cosmetics has increased as many people want to stay young and attractive. Hair care has become one of the fastest developing markets in the beauty industry.

Hair-care products may be defined as the preparation which is meant for cleansing, modifying the texture, changing of the colour, giving life to the stressed hair, providing nourishment to the hair and giving the healthy look to the hair. The real technology of cleaning the hair and scalp was developed in this century by the introduction of cake soap which was followed by the production of shampoo products.

The shampoo sector is probably the largest unit sale amongst the hair care products since shampoos are one of cosmetic products used in daily life. Shampoos are primarily been products aimed at cleansing the hair and scalp. [1]

The main aim of shampoo is to remove the unwanted particles such as dirt, oil, skin particles, dandruff, environmental pollutants and other contaminant particles from hair without losing much of sebum. Apart from the above-mentioned functions it also includes lubrication, conditioning, smoothing of hair surface and shining, anti-dandruff formulas etc to specially styled and colour-treated hair. [2]

The primary function of shampoo is aimed at the cleansing of the hair necessitated due to accumulated sebum, dust, scalp debris etc. Various shampoo formulations are associated with hair quality, hair care habit and specific problems such as treatment of oily hairs, dandruff and for androgenic alopecia.

Herbal shampoo [3, 4]

Herbal shampoos are the cosmetic preparations that with the use of traditional Ayurvedic herbs are meant for cleansing the hair and scalp just like the regular shampoo. They are used for removal of oils, dandruff, dirt, environmental pollutions etc.

II. MATERIALS AND METHODS:

Collection of plants

The dried and fresh plant materials were obtained from the local markets of Muvattupuzha, Kerala, India. These plants are then made into suitable forms and stored in air tight containers until it is further used in the formulation.

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 137-145 www.ijprajournal.com ISSN: 2249-7781

Preparation of a new herbal shampoo:

Table: 1

The herbal shampoo was formulated using the following eight natural ingredients. Selected herbal drugs were purchased from the authenticated agencies.

Sl.NO	Ingredients	Botanical name	Family
1	Wild mussaenda	Mussaenda frondosa	Rubiaceae
2	Reetha	Sapindus mukorossi	Sapindaceae
3	Aloe	Aloe vera	Liliaceae
4	Lemon	Citrus limon	Rutaceae
5	Peppermint	Mentha piperita	Labiatae
6	Tragacanth	Astragalus gummifer	Leguminosae
7	Castor oil	Ricinus communis	Euphorbiaceae
8	Gelatin	Bones, tendons and ligaments of cattles, sheeps etc.	

Functions of ingredients:

1. **Mussaenda:** It is a natural cleanser used traditionally for hair washing. It is a very good conditioner and makes the hair compact and smooth. It gives excellent shining to the hair. And leaves make excellent herbal shampoo.
2. **Reetha**: It is a cleansing agent, functioning as a detergent which keeps the scalp gentle and removes any microorganism responsible for infection. It nourishes hair, keep healthy and smooth also. It shines the hair and brings back nature texture. It is also helpful for removing dandruff.
3. **Aloe**: It strengthens the outer layer of hair called cuticle, and gives the hair a shiny reflective and uniform appearance. It helps in thickening of hair. It also helps to nourish hair and acting as an antiseptic and moisturizer.
4. **Lemon juice**: It maintains the pH of herbal shampoo. It gives a fragrance to herbal shampoo and prevents hair loss by giving protection against dandruff.
5. **Peppermint**: It is used for its cooling properties and fragrance. It may help to promote hair growth.
6. **Tragacanth**: It protects the natural beauty of the hair and leaves it soft and silky. It makes the hair thicker and gives it manageability. It also increases the shining and elasticity of hair.
7. **Gelatin**: It is a protein which supports the hair follicles and papilla and hair becomes softer and shinier without being greasy.
8. **Castor oil**: It has antibacterial and antifungal properties that can treat scalp infections and dandruff.
9. **Glycerine**:-It helps to look the moisture in hair.

Formula for the herbal shampoo:

Table: 2

SL.NO	INGREDIENTS	QUANTITY
1.	Mussaenda extracts	30 ml
2	Rita extracts	5g
3	Gum tragacanth	6g
4	Aloe vera gel	30ml
5	Castor oil	4ml
6	Glycerine	2ml
7	Lemon juice	5 ml
8	Peppermint oil	2ml
9	Alcohol	8ml
10	Gelatin solution (10%)	made upto 100ml

International Journal of Pharmaceutical Research and Applications
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III. METHOD OF PREPARATION:

Preparation of Herbal ingredients:

1. 100g of dried mussaenda leaves were extracted with 100 ml of distilled water by heating over a water bath for 5 minutes filtered and made upto 100ml with water.
2. 100 g of Reetha pericarps were extracted by cold maceration method using 100ml 70% alcohol to obtain10.7g of solvent free semi solid mass (yield-10.7% w/w).
3. 100 g of Aloe vera gel were soaked in distilled water and boiled for five minutes, filtered and made up to 100ml with water.
4. Lemon fruits were taken, squeezed and collected the juice.
5. Weighed accurately 6 g of Gum tragacanth powder and dissolved it in 8 ml of alcohol, stirred it in low flame and filtered.
6. Dissolved 10 g of gelatin in 100 ml of water by keeping the temperature at 35- 40^0 C to make 10% gelatin solution.

Formulation of herbal shampoo:

1. 5 g semi solid Reetha extract, 30ml each of Mussaenda and aloe extracts were added to tragacanth solution and were mixed by shaking for 20 min.
2. To this added measured quantity of castor oil and glycerine.
3. Few drops of peppermint essential oil were also added to impart aroma to the prepared shampoo.
4. Lemon juice (5ml) was also added to it with stirring to adjust the pH of the solution.
5. Keep stirring and add sufficient quantity of 10% gelatin solution to get a formulation of desired characteristics and kept in hot air oven for 30 minutes. After 30 minutes it is taken out and covered with aluminium foil and stored at room temperature.

For comparison, three commercially available herbal shampoos were purchased and named as MS1, MS2, and MS3 respectively.

Evaluation of herbal shampoos

For the evaluation and comparison of the formulated poly herbal shampoo and marketed herbal shampoo samples, first of all, quality control tests such as visual assessment and physicochemical factors like pH, density, viscosity and surface tension were performed. Secondly specific performance tests of shampoos including determination of dry residue moisture content, wetting time, dirt dispersion, cleaning action, foam ability and stability were also carried out. Special parameters like, ease of distribution, ease of rinsing, ease of combing (wet), ease of combing (dry), speed of drying and nature of hair after wash were also included for the detection of effectiveness of shampoos.

Evaluation parameters:

The different methods followed to evaluate the efficiency of marketed herbal shampoos and the newly prepared formulation was as follows:

1. **Physical appearance/ Visual inspection**

Both prepared and marketed formulations were evaluated in terms of their foam producing ability, fluidity, clarity, colour, odour and taste. Prepared shampoo was transparent, light brown, good foaming and had pleasant odour. Except colour and consistency, no noticeable differences were observed between commercial and formulated shampoo.

2. **Determination of pH**

The pH of 10% v/v shampoo solution in distilled water was determined at room temperature (25 ^{o}C) by using pH meter

3. **Determine percentage of solids contents**

A clean dry evaporating dish was weighed and added 4 gm shampoo to the evaporating dish. The dish and shampoo were weighed. The exact weight of the shampoo was calculated only and put the evaporating dish with shampoo was placed on the hot plate until the liquid portion was evaporated. The weight of the shampoo only (solids) after drying was calculated.

4. **Rheological evaluation**

The viscosities of the shampoos were determined by using Ostwald viscometer.

1ml sample of shampoo is taken in a glass beaker and then 100ml water is mixed to form a solution. The solution kept for 30 minutes. The density of the shampoo solution is determined using specific gravity bottle. The solution is taken in an Ostwald viscometer. The lower bulb of viscometer was filled with shampoo solution and upper bulb was filled by pipette pillar up to the mark. Then the sample was flowing freely from upper bulb and at the same time, the rate was detected by stopwatch. The process was made thrice to find the accurate value of the rate of flow. Water was used to calculate the relative viscosity of water sample.

Relative viscosity:

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 137-145 www.ijprajournal.com ISSN: 2249-7781

$$n_1 = (d_1t_1 / d_2t_2)\, n_2$$

n_1 -viscosity of sample
n_2 -viscosity of water
d_1 -Density of sample
d_2 -Density of water
t_1 -Average time of flow of sample in seconds
t_2 -Average time of flow of water in seconds

6. **Dirt dispersion test:**

Two drops of shampoo were added in a large test tube contain 10 ml of distilled water taken in a large test tube. To the above solution, 1 drop of India ink was added. The test tube was stoppered and shaken for 10times. The amount of ink in the foam was estimated by the rubric as None, Light, Moderate or Heavy.

5. **Cleansing action**

2.5 g of hair were placed in grease (0.5g), after that it was placed in 100ml water containing 0.5g of shampoo in a flask. The flask was shaked for 4 minutes at the rate of 50 times a minute. The solution was removed and sample was taken out, dried and weighed. The amount of grease removed was determined from the difference in their weight.

The percentage detergency power were determined by taking marketed formulations as control and prepared formulation as test using the following formula:

DP=100[1-(T/C)]

In which,
DP - Percentage of detergency power,
T - Weight of grease in test sample,
C - Weight of grease in control sample

7. **Wetting time**

Wetting ability of a solution is a function of its concentration. For an efficient solution the wetting time must be as low as possible, that is minimum the wetting time more efficient the solution. [5] A canvas paper was cut into 1-inch diameter discs having an average weight of 0.44 g. The smooth surface of disc was placed on the surface of 1% v/v shampoo solution and the stopwatch started. The time required for the disc to begin to sink was noted down as the wetting time. Table 2 shows that, the wetting time of all the three shampoos was minimum and all the three shampoos were found to be of good quality.

8**. Surface tension Measurement**

Measurements were carried out with a 1% w/v shampoo dilution in distilled water at room temperature. Thoroughly clean the stalagnometer using chronic acid and purified water. The data calculated by the following equation given below:

$$\gamma = 2\pi r / W$$

9. **Foaming ability and foam stability**

Cylinder shake method was used for determining foaming ability. 100ml of 1% shampoo solution was put into a 500 ml graduated measuring cylinder and was covered the cylinder with one hand and shaken for 10 times. The total volumes of the foam contents after 1 minute shaking were recorded. Only the foam volume was calculated. Immediately after shaking the volume of foam at 1 minute interval for 4 minutes were recorded.

10. **Ease of distribution**

Ease of distribution was performed by applying 5ml of the formulation over the wet hair and the time taken to complete the distribution was measured.

11. **Ease of rinsing**

The time taken to remove the detergent was performed by applying 5 ml of the shampoo and time taken for complete removal of frothing from wash water was determined.

12. **Ease of combing (Wet)**

Ease of combing was performed by passing a comb through the wet hair and checking whether the comb glides smoothly.

13. **Speed of Drying**

The speed of drying was performed by applying 5ml of the shampoo in hair and dried after washing. The drying of hair was performed by using a table fan with constant speed and distance from the subject.

14. **Ease of Combing (Dry)**

Ease of combing was performed by passing a comb through the dry hair and checking whether the comb glides smoothly.

15. **Nature of hair after wash**

Nature of hair after wash was done by applying a small quantity of the shampoo on hair and then washed. [5]

IV. RESULTS AND DISCUSSION:

Evaluation of herbal shampoos

The physical properties, cleansing action, dirt dispersion, foaming ability of marketed herbal

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 137-145 www.ijprajournal.com ISSN: 2249-7781

shampoos and prepared formulations were evaluated. The data obtained from the evaluation shows that all the marketed shampoos and prepared formulation are having the similar effect.

- **Physical Appearance**

The results of visual inspection of series of formulations are listed in Table: 3. The two marketed formulations (MS1 & MS2) are light green in colour and the other marketed formulation (MS3) is dark purple in colour which makes the formulations attractive to the customers. The newly developed formulation is light brown in colour (original colour of the formulation).For better appearance, compactable and approved artificial colours are added in the commercial shampoos. All the formulations had good characteristics like pleasant smell, elegant appearance and suitable consistency.

Table: 3. Evaluation of Formulation for physical appearance, odour, taste

Sl. No	Samples	Physical Appearance	Odour	Taste
1	F-1	Light brown, good foaming	Pleasant	Bitter
2	MS-1	Light green, good foaming	Pleasant	Bitter
3.	MS-2	Light green, good foaming	Pleasant	Bitter
4.	MS-3	Dark purple, good foaming	Pleasant	Bitter

F1: prepared shampoo, MS-1, MS-2 and MS-3: marketed herbal formulations

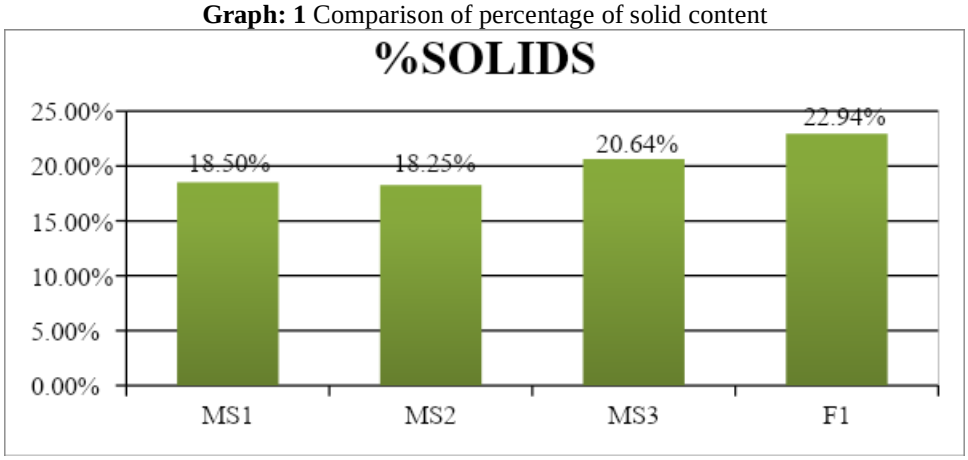
- **pH, % solid content, dirt dispersion and wetting time**

pH: The pH of shampoos has been shown to be important for improving and enhancing the qualities of hair, minimizing irritation to the eyes and stabilising the ecological balance of the scalp . The current trend to promote shampoos of lower pH is one of the ways to minimize damage to hair. Mild acidity prevents swelling and promotes tightening of the scales, thereby inducing shine to hair. From Table: 4 it is evident that the pH of newly developed formulation is slightly less than that of marketed formulation. But all the shampoos were acid balanced which is near to skin pH.

Percentage solid content: If the shampoo has more solid content, it will be hard to work in to the hair [6]. The result of percent of solid contents is tabulated in Table: 4. As compared to the marketed formulations, the newly developed shampoo contain more percentage of solid and less moisture content. But the overall results show that they were easy to wash out.

Dirt dispersion: Shampoo that cause the ink to concentrate in the foam is considered as poor quality, the dirt should stay in water. Dirt that stays in the foam will be difficult to remove. These results indicate that no dirt would stay in the foam, so prepared and marketed formulation is satisfactory.

Graph: 1 Comparison of percentage of solid content



International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 137-145 www.ijprajournal.com ISSN: 2249-7781

Table: 4. Evaluation of pH, % solid content, dirt dispersion and wetting time

Sl. No	Samples	pH	%solid	Dirt Dispersion (Presence of ink in the form)	Wetting time (in seconds)
1	**F-1**	6.01±0.02	22.94±0.03	None	191
2	MS-1	6.87±0.04	18.5±0.01	None	167
3	MS-2	6.82±0.12	18.25±0.04	None	174
4	MS-3	6.67±0.01	20.64±0.02	None	180

F1: prepared shampoo, MS-1, MS-2 and MS-3: marketed herbal formulations

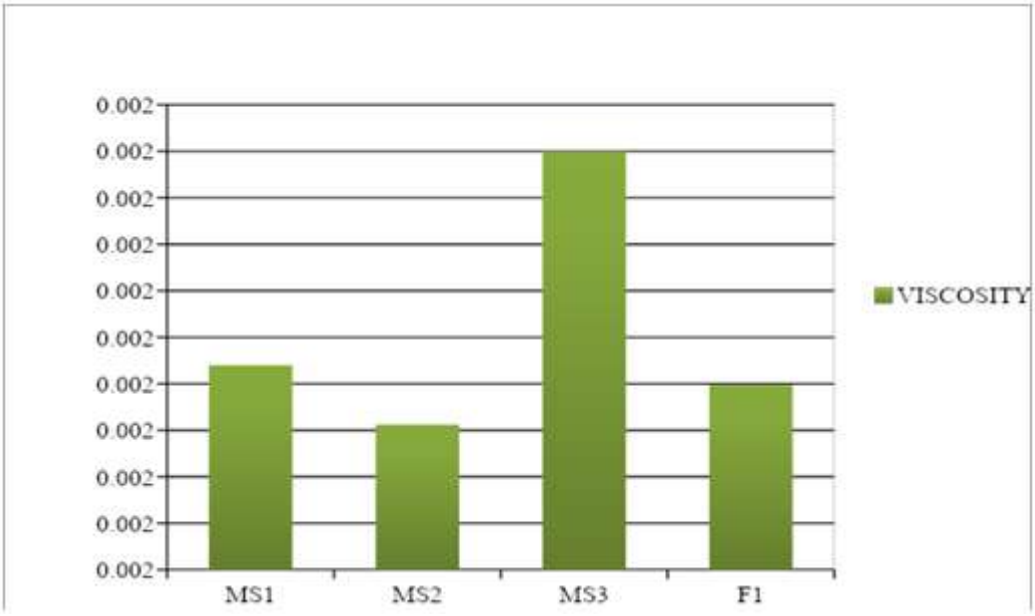
- **Density, viscosity and surface tension**

Viscosity have an important role in explaining and controlling many attributes like shelf life stability and product aesthetics such as clarity, ease of flow on removal from packing and spreading when apply to hair. More viscosity of shampoo should produce a good amount of foam. Here, density and viscosity of F1 is greater than that of MS2 and less than that of MS1 and MS3.A proper shampoo should be able to decrease the surface tension of pure water to about 40dynes/cm.[7] Table: 5 shows that, F1 is having with more surface tension than that of all other marketed formulations we studied.

Table: 5 Evaluation of density, viscosity and surface tension

Sl. No	Samples	Density	viscosity	Surface tension (Dynes/cm)d/cm)
1	F-1	1.0315	$2.049x10^{-3}$	35.13
2	MS-1	1.0915	$2.07x10^{-3}$	33.59
3	MS-2	0.958	$2.006x10^{-3}$	33.93
4	MS-3	1.0432	$2.30x10^{-3}$	29.45

Graph 2: Evaluation and comparison of viscosity



International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 137-145 www.ijprajournal.com ISSN: 2249-7781

- **Cleansing action and Detergency power**

Cleansing action was tested on hair in grease (oil). Cleaning is the primary function of a shampoo, experimental detergency evaluation has been difficult to standardise, there is no real agreement on a standard soil, a reproducible soil in process or the amount of soil a shampoo should ideally removed. [8] The percentage of sebum removed using the formulations are given in Table: 6. From the table, the percentage of sebum removed while using MS1,MS2 and MS3 is found to be more than that of F1. So they shows more cleansing action. The detergency power of formulated shampoo is also determined by comparing with each marketed formulation and tabulated in Table: 6. As compared to MS1, MS2 and MS3, detergency power of F1 is high, moderate and low respectively.

Table: 6 Evaluation of cleansing action

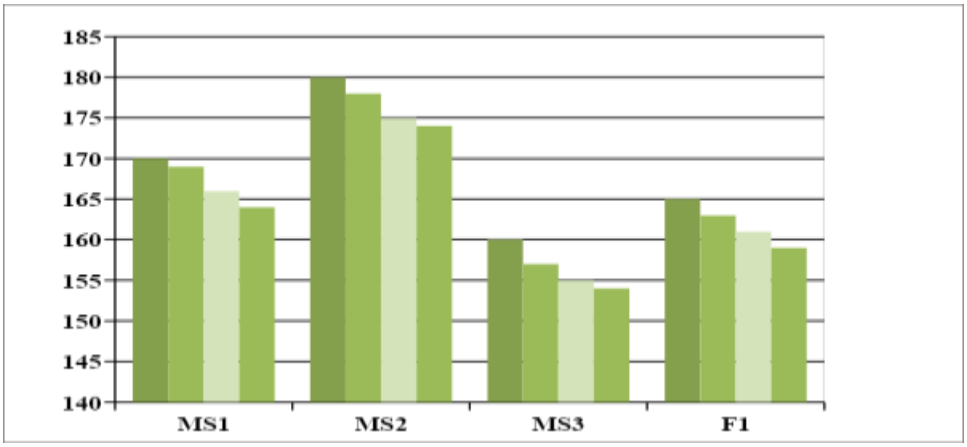
Sl. No	Samples	Total wt of Hair+ Grease (g)	Wt of Hair after cleansing (g)	Wt of sebum removed (g)	Cleansing action (%)	Detergency power (DP) 100(1- T/C)
1.	F-1	3	2.679	0.321	64.2	25.6±0.004
2.	MS-1	3	2.530	0.461	92.2	30.4±0.002
3.	MS-2	3	2.580	0.420	84	23.6±0.001
4.	MS-3	3	2.601	0.399	78	19.6±0.005

- **Foam stability of herbal shampoo:**

While considering a shampoo for use, the customers give more importance to its foaming property. It's merely based on a false notion that good foaming shampoo will be more effective. Anyway such a wrong sense makes the people attracted to more foaming shampoos. Nowadays, shampoos with more foaming ability and foam stability have good market. Table: 7 show that all the formulations we studied have good foaming ability and similar foam stability. The time for persistence of foam shows its stability. Here all the four formulation we studied have better foam stability.

Table: 7 Evaluation of foam stability of herbal shampoo:

Sl. No	Time (min)	Foam volume (ml)			
		MS-1	MS-2	MS-3	MS-4
1	**1**	**170**	**180**	**160**	**165**
2	**2**	**169**	**178**	**157**	**163**
3	**3**	**166**	**175**	**155**	**161**
4	**4**	**164**	**174**	**154**	**159**



Graph 3: Comparison of foam stability

International Journal of Pharmaceutical Research and Applications
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- **Other evaluation parameters**

Table: 6 clearly reveal that the herbal formulation was a bit lagging in distribution when compared to marketed herbal formulations. In the case of ease of rinsing herbal formulation was rinsed out quickly whereas the commercial herbal shampoos were not. The herbal formulation was compared with commercially available herbal shampoos and found that the herbal formulation is not only safer than the chemical conditioning agent, but also they reduce the protein loss during combing. In case of combing (wet) the entire three treated sample was found a bit hard for combing. In speed of drying they showed nearly same time for drying. [9]

Table 8: Other evaluation parameters:

Parameters	MS 1	MS2	MS3	Formulated Shampoo
Ease of distribution	+++	+++	+++	++
Ease of rinsing	++	++	++	+++
Ease of combing (wet)	++	++	++	++
Speed of drying	14minutes	12minutes	14minutes	12 minutes
Ease of combing (dry)	++	++	++	+++
Nature of hair after wash	Soft and silky	Soft and manageable	Greasy Appearance	Soft and compact

V. CONCLUSION:

The present study was carried out with the aim of preparing the herbal shampoo for hair cleansing, which is safer than the chemical conditioning agents. Herbal shampoo was formulated with the aqueous extract of naturally occurring drugs that are commonly used for cleansing hair traditionally. Use of conditioning agents (synthetic) reduces the protein and may leads to hair loss. To provide the effective conditioning effects, the present study involves the use of Reetha and other plant extracts instead of synthetic conditioners. The main purpose behind this investigation was to develop a stable and functionally effective shampoo by excluding all types of synthetic additives and also to evaluate and compare the physicochemical properties with that of marketed formulations. The physicochemical evaluation of newly formulated herbal shampoo showed ideal results. It demonstrated good foaming ability and foam stability, high detergency power, good cleansing property, low surface strain, and execution of good conditioning. The results of the evaluation study of the developed shampoo revealed a comparable result, but further scientific validation is needed for its overall development of quality and safety.

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