RESEARCH ARTICLE

Development and Evaluation of Herbal Shampoo as an Antifungal Formulation

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ABSTRACT

The herbal shampoo is a normal hair care solution used to clear out grease, debris and dandruff, stimulating hair growth and strength. It also gives the hair a glossy appearance and smoothness, reducing tenderness. This research aims to develop an herbal shampoo and assess its physical and chemical properties with an eye toward ensuring its safety and effectiveness. Moreover, it also aims to replace hazardous synthetic chemicals and with safe natural ones. Herbal shampoo was formulated using plants viz Tea, ashwagandha, sandalwood and Nagarmotha which compared with the marketed formulation. Various physicochemical tests were carried out, like visual inspection, pH, detergency, dirt dispersion, determination of foam, viscosity and stability evaluation, and antimicrobial activity. It was observed that prepared herbal shampoo had good cleansing properties and was very efficient in controlling the growth of *Candida* and *Malassezia* fungi.

Keywords: Tea, Nagarmotha, Ashwagandha, Sandalwood, Herbal shampoo, *Malassezia, Candida* fungi.

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INTRODUCTION

Human beauty is fundamentally based on the hair. Healthy hairs may induce a state of self-confidence. Hair helps in regulation of body temperature by protecting against sun and cold weather. Shampoos are a viscous mixture of surface-active agents (surfactants) used for cleansing. The main aim of shampoos is to remove unwanted build-up of dirt, debris and dandruff without stripping out the natural oils from the hair and thus provide nourishment to the hair and scalp.[1] There is a wide range of shampoos on the market today, from those that are synthetic to those that are herbal, from those that are medicated to those that are not. Shampoos with synthetic ingredients cause harmful adverse effects like scalp inflammation, hair fall, hair dryness, split ends, hair greying and scalp irritation. Herbal shampoos consist of various natural plant extracts with different properties like cleansing, conditioning, smoothening, antidandruff, antimicrobial, etc.; thats how they promote hair growth and strengthen hairs.[2] Thus, herbal shampoos have gained an extensive demand nowadays.

The shampoo should produce a good amount of foam. It should have good stability and be effective to remove dirt completely. Hair should be left silky, shiny, and moisturized after a simple water washing.[3] From the literature survey, in the present study we have prepared herbal shampoos of tea (*Thea sinensis*), nagarmotha (*Cyperusrotundus*), ashwagandha (*Withania somnifera*), sandalwood (*Santalum album*) as an active ingredient.[4-12]

MATERIAL AND METHOD

Materials

The *Malassezia furfur* strain (MTCC-1374), was obtained from India's microbial type culture collection and Gene Bank. Sandalwood oil was purchased from the local market of Pune, India. Other excipients added for shampoo preparation e.g., Carbopol and triethyl amine were purchased from molychem, Mumbai, India. Benzalkonium chloride and sodium lauryl sulfate were purchased from LobaChemei, Mumbai, India.

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Preparation of Extract

Weigh accurately about 100 g of each powdered plant material, namely tea, nagarmotha and ashwagandha, and transfer to a conical flask containing ethanol solvent. It was mixed well and shaken for 1-hour by using an orbital shaker. The mixture was kept stable for 24 hours and then filtered. The filtrate was then collected and evaporated. The dried extracts were used for the preparation of herbal shampoo.

Evaluation of Herbal Shampoo

Prepared formulations as per composition given in Table 1 were evaluated for visual evaluation, assurance of solid content, dirt dispersion, pH, detergency, determination of foam, viscosity, stability, and antimicrobial activity.[13]

Visual inspection

Herbal shampoo formulation was assessed for odor color, and clarity etc.[14]

Surface tension

The 10% v/v solution density of all the shampoos was measured at room temperature using a pycnometer. This sample was then filled in a stalagmometer and surface tension was measured.[15]

Foam test

The small amounts of 10% v/v shampoo solutions were taken in test tubes with oil and without oil. Each test tube was shaken twenty times and foam height was measured in mL at 0, 5, 10, 15 and 20 minute intervals with the help of a scale.[16]

Stability test for foam

A 10% v/v shampoo solution was filled in burette. The solution from the burette was then allowed to pass into the measuring cylinder in order to form foam. The height of foam was measured as soon as the burette became empty. The same procedure was followed with oil.[17]

Sag test

A size amount of shampoo was placed at the center of the sieve with mesh no.16. When water from a burette was introduced onto the shampoo, foam developed and shampoo as well as foam passed from the sieve along with water. The volume of water needed to flush out all of the shampoo and foam from the sieve was recorded.[17]

pH determination

A 10% v/v solution of each shampoo was prepared and pH of each shampoo solution were evaluated using a digital pH meter at room temperature.[18]

Viscosity

The viscosity was evaluated using a miniature adapter spindle for a sample. Each bottle of shampoo was placed in a designated container, the contents of which were not allowed to overflow. Herbal shampoos' viscosities were measured at various rotations per minute.[19]

Dirt dispersion test

Each test tube contained a shampoo solution diluted with Indian ink to a final volume of 10 mL (10% v/v). Each tube underwent longitudinal oscillations to generate foam, and the ink migration in the foam was observed.[20]

Table 1: Composition of herbal shampoo

Sr. no	*Content*	*Quantity Required*			
		F1	*F2*	*F3*	*Final*
1	Carbopol (g)	0.45	0.25	0.37	0.37
2	TEA (drop)	1–2	1–2	1–2	1–2
3	Sodium lauryl sulfate (mL)	5 (4% solution)	5 (4% solution)	5 (4% solution)	5 (4% solution)
4	Benzalkonium Chloride (mL)	0.05	0.05	0.05	0.05
5	Tea extract (gm)	0.5	0.5	0.5	0.5
6	Nagarmotha extract (gm)	0.5	0.5	0.5	0.5
7	Ashwagandha extract (gm)	0.5	0.5	0.5	0.5
8	Sandalwood oil (gm)	0.5	0.5	0.	0.5
9	Distilled water (mL)	50	50	50	50

Cleansing test

Different hair braids were made and weighed. Coconut oil were applied to the braids and weight was measured. Further, it was washed using shampoo, dried properly, and then weighed again. The cleansing ability of polyherbal shampoo was observed and recorded.

Antimicrobial activity

The agar well diffusion method was used to compare the shampoo solutions' antibacterial effectiveness to that of a typical shampoo formulation against the following microorganisms: *Candida albicans* and *Malassezia furfur.* The experiment was performed using a Sabouraud dextrose agar (SDA) medium. The appropriate amount of SDA was dissolved in distilled water and boiled. This solution is then autoclaved and cooled at 45 to 50°C. The solution is then poured into petri plates and allowed to solidify. The fungal solution is then spread on the plates.[21-23]

IC_{50} values

The IC_{50} values of all the shampoos having different extracts were calculated with the help of line equation.

RESULT AND DISCUSSION

As more and more individuals look for non-toxic ways to care for their hair and scalp, antidandruff herbal shampoos have

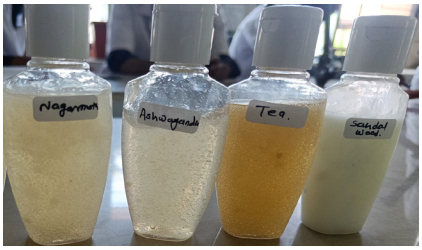

Figure 1: Formulation of herbal shampoos

become increasingly popular. In the present study, herbal shampoo formulated using herbs ashwagandha, nagarmotha, tea and sandalwood and evaluated using various parameters are given below:

Visual Assessments

The visual assessment test was done and it was found that all herbal shampoo formulations had a pleasant odor. The color was also noted in Figure 1 as sandalwood was found to be milky white, tea was found to be light brown, ashwagandha was found to be white and nagarmotha was found to be cream color.

Surface Tension

Each shampoo formulation's surface tension was measured and compared to the industry standard. The surface tension of sandalwood, tea and ashwagandha were was found to be 34.05, 32.67 and 33.46 dynes/cm, respectively. These values were compared with the standard formulation and it was observed that all the formulations showed an increase in surface tension as given in Figure 2.

Foam Test

Shampoo formulations were subjected to a foam test and compared to commercially available reference formulations to determine how well they foamed. This test was determined by measuring each formulation's foam height as given in Figure 3. Utmost foam was formed in shampoo with standard followed by nagarmotha, ashwagandha, sandalwood, tea and control.

Foam Stability Test

Standard procedures were followed to conduct a foam stability test, and the stability of foam produced by each shampoo formulation was compared to that of a commercially available standard. Shampoos made with nagarmotha and sandalwood have been found to have superior foam stability to the industry norm (Figure 4).

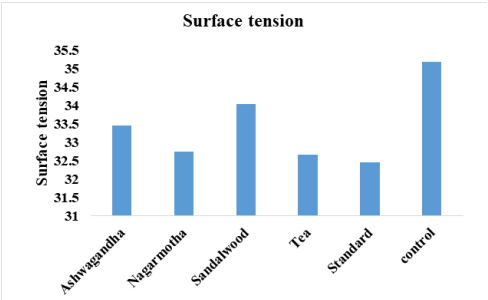

Figure 2: Surface tension of different herbal shampoo formulations

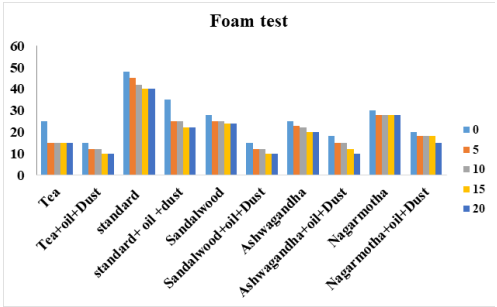

Figure 3: Foam test of different herbal shampoo formulations

Sag Test

Shampoo made with ashwagandha and tea had the lowest sag test water requirements compared to the industry standard shown in Figure 5.

pH Determination

The pH of all formulated shampoo were determined and given in Figure 6.

Viscosity

When evaluating the flow characteristics of liquid and semisolid substances, viscosity testing is crucial. The compatibility of formulation with the packaging system is considerably affected by viscosity. The viscosity of all shampoo formulations was examined using Brookfield Viscometer and found to be almost equivalent to the concentration given in Figure 7.

Dirt Dispersion Test

The efficacy of each shampoo formulation was evaluated in comparison to the industry standard utilizing the dirt

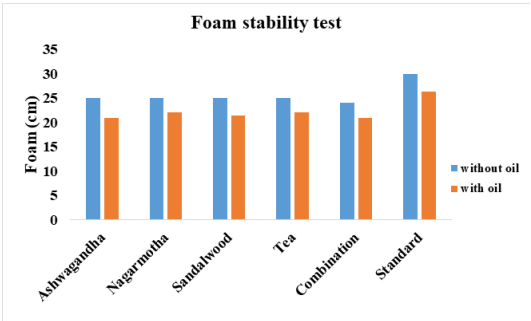

Figure 4: Foam stability test of different herbal shampoo formulations

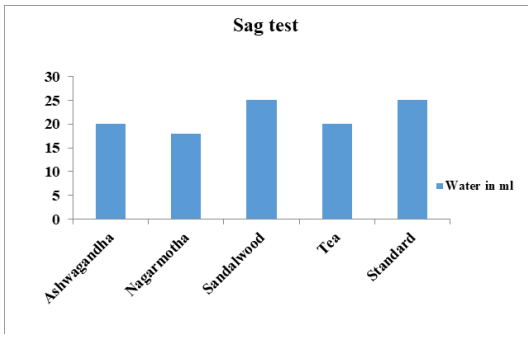

Figure 5: Sag test of different herbal shampoo formulations

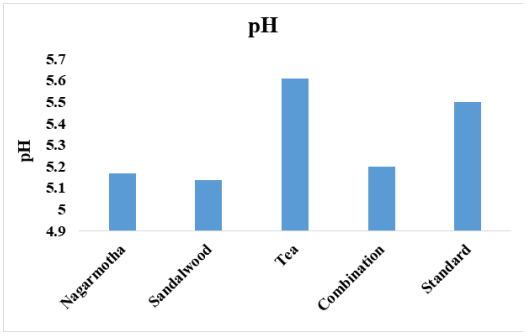

Figure 6: pH of different herbal shampoo formulations

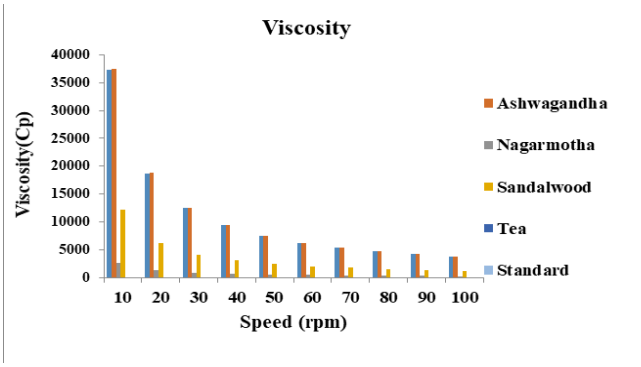

Figure 7: Viscosity of different herbal shampoo formulations

dispersion test, which was conducted with Indiana ink. The filth dispersion test shown in Figure 8 was successfully completed by shampoos manufactured with all-natural ingredients, including the standard.

Cleansing Ttest

This test emphasizes a comparative analysis of all shampoo formulations' cleansing abilities. It was practical that shampoo containing ashwagandha, nagarmotha, sandalwood and tea has significantly greater cleaning power than the marketed shampoo given in Figure 9.

Antimicrobial Activity

The fungi *C. albicans* and *M. globosa* were used in the agar diffuson experiment to determine the antibacterial activity. It was shown that the antimicrobial activity of tea, nagarmotha, ashwagandha exctracts and sandalwood oil shampoos against *Candida* and *Malassezia* is effective and compared with standard marketed formulations. Natural treatments are effective against *Malassezia* fungus, as demonstrated by these results. Each natural therapeutic substance was shown to have some degree of success in reducing the proliferation of dandruff-causing microorganisms. Figures 10A, B, and C show the various levels of growth inhibition caused by each treatment, and Figure 11 displays their respective IC_{50} values after being compared.

DISCUSSION

The popularity of cosmetics has skyrocketed during the past few decades. When compared to their competitors, shampoos, face powders, lipsticks, and nail polishes come out on top. Hair can be damaged by synthetic surfactants, plasticizers, and dyes that are sometimes used in hair care products. Soaps are commonly used to remove greasy residues from previously used shampoos and conditioners. Herbal ingredients are becoming increasingly popular in the cosmetics industry as a means to eliminate toxins and improve user satisfaction. As more and more individuals look for non-toxic ways to care for their hair and scalp, antidandruff herbal shampoos have become popular. Ashwagandha, nagarmotha, and tea have all been employed in recent studies' formulations.[24]

The primary purpose of this research was to determine the feasibility of formulating antidandruff shampoos using only natural components. Compared to the gold standard,

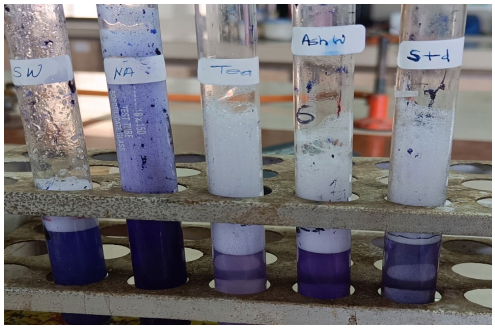

Figure 8: Dirt dispersion test of different herbal shampoo formulations

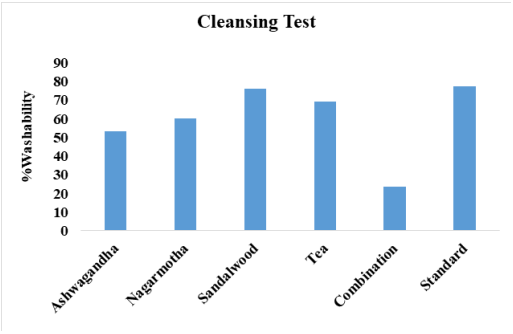

Figure 9: Cleansing test of different herbal shampoo formulations

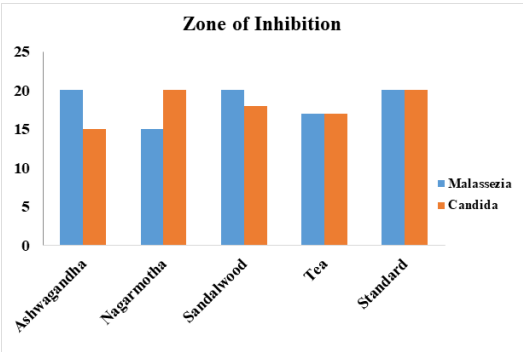

Figure 10A: Zone of inhibition inmm for antifungalactivity of different herbal shampoo formulations for *Candida* and *Malassezia*

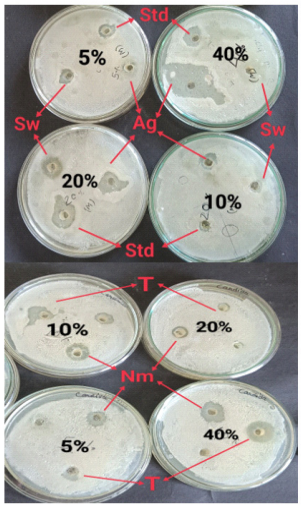

Figure 10B: Antifungal activity of different herbal shampoo formulations against *Candida*

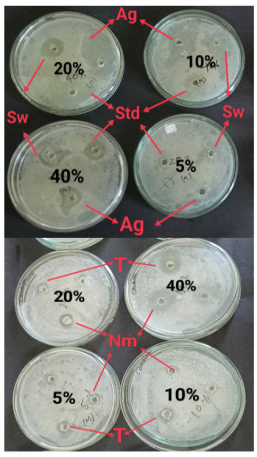

Figure 10C: Antifungal activity of different herbal shampoo formulations against *Malassezia*

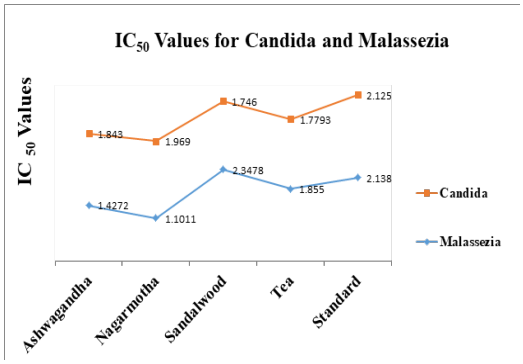

Figure 11: IC_{50} values of different herbal shampoo formulations for *Candida* and *Malassezia*

the surface tension of shampoos made with ashwagandha, nagarmotha, tea extract, and sandalwood oil was satisfactory. Oil and grime on the scalp can be washed away thanks to the surfactant characteristic. The enhanced cleanliness provided by this shampoo is another proof of this. Consumers can't pick a shampoo unless it produces foam. Although it has little to no effect on cleaning performance, it does provide a sense of fulfillment to the buyer. All shampoos were found to have stable foam. The surface tension is crucial to keeping the foam around. Shampoos with a higher surface tension were found to produce significantly more foam. The herbal additives did not noticeably change the consistency. All of the herbal medications tested positive for compatibility with the excipients used in the creation of density (carbomer and triethylamine). The sag test measures how well a shampoo rinses out of the scalp and how much water is needed to remove shampoo and the resulting froth from thick hair. This analysis is important for places with a water shortage since it offers adjustments to the formula. Sag testing revealed that shampoos made with ashwagandha and tea used the least amount of water during the rinsing process. Consequently, shampoos developed for distribution in areas experiencing a drought should include these components. The ability of a shampoo to disperse dirt suggests that it can also dissolve oil. The filth and shampoo will return to the scalp if they are not removed from the created foam. Therefore, the filth is anticipated to continue to dissolve in the shampoo solution, making for a simple cleaning process. Since all shampoos have the same basic formulae, it was found that their pH levels were between 5 and 5.5, making them roughly comparable to normal limits. Because it produces so much sebum, the human scalp is a breeding ground for bacteria. As a result, it needs to be cleaned regularly and thoroughly using a suitable washing agent such shampoo. Nagarmotha was found to be more effective than shampoos made with ashwagandha, tea, and sandalwood oil against *Malassezia* and *C. albicans* (all of which had good IC_{50} values).

CONCLUSION

Our research supports previous claims that adding ashwagandha, nagarmotha, sandalwood oil, and tea to your routine cleaning routine can improve its efficacy. In addition, studies have shown that adding sandalwood and nagarmotha helps eliminate dandruff while simultaneously increasing foam production and preserving foam stability. In order to create effective shampoos, more study in this area, including the incorporation of similar medications, needs to be emphasized. Therefore, we infer that the incorporation of herbal components into shampoo contributes to the product's desirable performance as an antifungal agent.

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