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Formulation and evaluation of herbal Anti-dandruff shampoo

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Abstract

Shampoos are the products which removes surface grease, dust from the hair shaft and scalp. Majority of ingredients in the shampoos are chemicals and hence have been under severe attack due to its potential risk of side effects with its usage. The main objective of this study was to eliminate harmful synthetic ingredient from anti-dandruff shampoo formulation and substitute them with a safe natural ingredients. An attempt has been made to combine modern formulation technology in to a formula based on natural ingredients. Herbal shampoo was prepared with Ritha fruits, Liquorice stolons, Bengal gram seeds, Brahmi leaves, Greengram seeds were collected from Ayurvedic store and remaining like Banana roots, Pomegranate seeds, Hibiscus leaves, Marigold flowers, and Lemon fruits with all ingredient extract and formulated different formulations and stability tested with marketed Dove shampoo. Formulation four was found to be the best formulation based on the evaluation parameters and stability studies. When investigation data were assessed, formulation four of anti-dandruff herbal shampoo contains all good characters of an ideal shampoo and it was found to be harmless, more effective and economical compared to synthetic Dove anti dandruff shampoo, it was quite evident that development of stable, effective anti-dandruff herbal shampoo which may be commercially replacing the existing synthetic shampoo is quite possible.

Keywords: anti-dandruff, evaluation, formulation, herbal, shampoo and synthetic

Introduction

Plants contain a number of chemical compounds which perform biological functions including defense against insects, fungi, herbivorous and mammals.

Dandruff is a common scalp disorder affecting almost half of the population at the post-pubertal age and of any sex and ethnicity. It often causes itching. It has been well established that keratinocytes play a key role in the expression and generation of immunological reactions during dandruff formation. The severity of dandruff may fluctuate with season as it often worsens in winter. Most cases of dandruff can be treated with specialized shampoos. Those affected by dandruff find that it can cause social or self-esteem problems, indicating treatment for both psychological and physiological reasons.

Shampoo is a hair care product, typically in the form of a viscous liquid that is used for cleansing hair. The goal of using shampoo is to remove the unwanted build-up in between the hair without stripping out so much sebum as to make hair unmanageable. Shampoo is generally made by combining a surfactant, most often sodium lauryl sulfate or sodium laureth sulfate, with a co-surfactant, most often cocamido propyl betaine in water.

Synthetic shampoos may cause side effects so keeping this in view an herbal anti-dandruff shampoo has been formulated and evaluated scientifically. In Indian system of medicine, various plants its parts have been used for treatment of dandruff such as Ritha, Liquorice, Brahmi, Hibiscus, Bengal gram, marigold. Traditionally, single plants have been used & there was no scientific report available regarding totally all ingredients are natural regarding usage of such combination that we have conceived.

Materials and Methods

All plant materials like Ritha fruits, Liquorice stolons, Bengal gram seeds, Brahmi leaves, Greengram seeds were collected from Ayurvedic store and remaining like Banana roots, Pomegranate seeds, Hibiscus leaves, Marigold flowers, and Lemon fruits were collected in and around Hyderabad. Collected plant parts were washed with tap water and shade dried. Shade dried material was powdered and stored in air tight container for further use. The purpose of use in the herbal shampoo and its details are mentioned below table 01.

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Table 1: List of ingredients used in preparation of herbal antidandruff shampoo

| S. No | Name of the plant | Part used | Scientific name | Purpose |
|-------|-------------------|-----------|------------------------------|----------------------|
| 1 | Ritha | fruits | <i>Sapindus mukorosis</i> | Detergent |
| 2 | Liquorice | stolon | <i>Glycyrrhiza glabra</i> | Detergent |
| 3 | Bengal gram | seeds | <i>Cicer arietinum</i> | Hair growth |
| 4 | Brahmi | leaves | <i>Centella asiatica</i> | Hair tonic |
| 5 | Green gram | beans | <i>Vigna radiata</i> | Anti-dandruff |
| 6 | Banana | roots | <i>Musa acuminata</i> | Coloring agent |
| 7 | Pomegranate | seeds | <i>Punica granatum</i> | Anti-dandruff |
| 8 | Hibiscus | leaves | <i>Hibiscus rosasinensis</i> | Hair growth promoter |
| 9 | Marigold | flowers | <i>Calendula officinalis</i> | Conditioner |
| 10 | Lemon | fruits | <i>Citrus limon</i> | Preservative |

Preparation of shampoo

Accurately 50grams of all powdered crude drugs were taken, extracted with distilled water at below 60 °C individually. Aqueous extracts of all the crude drugs were measured and mixed in required quantities as shown in the table 02. Developed shampoo was stored in a suitable container and used for further evaluations ^[1, 2, 3].

$$R_2 = \frac{(W_3 - W_1) N_1 \times R_1}{(W_2 - W_1) N_2}$$

W1 is weight of empty beaker. W2 is weight of beaker with distilled water

W3 is Weight of beaker with shampoo solution. N1 is no. of drops of distilled water.

N2 is no. of drops of shampoo solution. R1 is surface tension of distilled water at room temperature. And R2 is surface tension of shampoo solution

Table 2: Different formulations of herbal anti-dandruff shampoo

| Ingredients | F1 | F2 | F3 | F4 |
|------------------------------|-----|-----|-----|------|
| <i>Musa acuminata</i> | 2ml | 2ml | 2ml | 2ml |
| <i>Centella asiatica</i> | 3ml | 3ml | 4ml | 5ml |
| <i>Vigna radiata</i> | 4ml | 5ml | 5ml | 6ml |
| <i>Cicer arietinum</i> | 3ml | 5ml | 6ml | 5ml |
| <i>Punica granatum</i> | 4ml | 4ml | 5ml | 6ml |
| <i>Calendula officinalis</i> | 2ml | 2ml | 2ml | 2ml |
| <i>Hibiscus rosasinensis</i> | 2ml | 2ml | 2ml | 2ml |
| <i>Glycyrrhiza glabra</i> | 3ml | 5ml | 5ml | 5ml |
| <i>Sapindus mukorosis</i> | 6ml | 8ml | 9ml | 10ml |
| <i>Citrus limon</i> | 1ml | 1ml | 1ml | 1ml |

Evaluation of prepared shampoo

Physical appearance/visual inspection: Developed formulation was evaluated for their clarity, color and odour. All evaluations were reported and discussed.

Determination of pH: Developed formulation was diluted using distilled water to prepare a sample with 10 % concentration. The prepared sample was checked for pH using a digital pH meter at room temperature 30±2°C.

Determination of percentage solids contents: A clean dry china dish was weighed and added with 4 grams of shampoo. The dish with shampoo was weighed. The exact weight of the shampoo was calculated. The china dish with shampoo was placed on the hot plate until the liquid portion was evaporated. The weight after drying was calculated.

Measurement of viscosity: The viscosity of the shampoo was determined by using Brookfield Viscometer LVDV Prime-I. The viscosity of shampoo was measured at room temperature i.e. 30±2°C with varying rpm and torque.

Surface tension measurement: Dilute the shampoo using distilled water to fix 10% as concentration. Measurements were carried out using stalagmometer. Dip the flattened end of stalagmometer in to beaker containing sample of developed shampoo and suck it until the level reaches the mark. Fix that in the stand and allow the sample to run slowly from the mark. Count the number of drops formed when level of liquid reaches from A to B. Repeat the experiment with distilled water. The data was calculated using following equation,

Cleaning action: 5 grams of wool yarn was added in grease and it was placed in flask containing 200 ml of water with 1 gram of shampoo. Temperature of content in the flask was maintained at 30±2°C. The flask was shaken for 4 minutes at the rate of 50 shakes per minute. The solution was removed and sample was taken out, dried and weighed. The amount of grease removed was calculated by using the following equation

$$DP = 100(1 - T/C)$$

In which, DP= percentage of detergency power, C= weight of sebum in the control sample and T= weight of sebum in the test sample

Foaming ability and foam stability: Cylinder shake method with slight modification was used for determining foaming ability. 50ml of the 1% shampoo solution was put into a 250 ml graduated measuring cylinder and covered with hand. Measuring cylinder was shaken for 1 minute. The total volume of the foam contents after 1 minute shaking was recorded. The procedure was continued for 5 minutes ^[4, 5].

In-vitro anti-dandruff activity: *Candida albicans* were employed for testing antifungal activity using the cup-plate method. The culture was maintained on sabouraud's agar slants. 20 ml of melted sabouraud's agar medium was inoculated with 0.2 ml of 72 hour old suspension of *Candida albicans* and poured in to a Petri dish. The cups (10 mm diameter) were punched in the Petri dishes and filled with 0.05ml of a solution of the sample dissolved in DMSO (10 ml of shampoo in 100 ml of DMSO). The plates were kept for diffusion at 4°C for one hour and incubated at 30°C for 48 hours as shown in below figure. After the completion of incubation period, the zone of inhibition in millimeter was measured ^[6, 7, 8].

Stability studies: Stability studies were performed in accordance with ICH guidelines for accelerated testing with required modifications. The sample taken formulation was taken and kept at room temperature (30 ± 2°C) as well as refrigerator (4±2°C) for duration of one month. The samples

were tested for their physical appearance, pH, viscosity, % cleaning action and foam stability.

Results and Discussion

The stability study has been done after immediately

formulating the shampoo (Table-03) and after one month (Table-5). Phytochemical screening showed that the extracts were rich in saponins, alkaloids, flavonoids, phenolic compounds, amino acids etc.

Table 3: Comparison of formulated with marketed shampoo

| Evaluation parameters | Formulated shampoo | Marketed shampoo (Dove) |
|-----------------------|--------------------|-------------------------|
| Color | Light brown | White |
| Odor | Pleasant | Pleasant |
| Transparency | Thick | Milk opaque |
| pH | 6.6 ± 0.5 | 6.1 ± 0.5 |
| % Solid content | 25.75± 2% | 23± 2% |
| Foam volume | 98 ± 5ml | 115± 5 ml |
| Surface tension | 30.68±0.5 dyne/cm | 38.72± 0.5dyne/cm |
| Wetting time | 140 sec | 187 sec |

Cleansing action was tested on wool yarn in grease. The efficiency of developed formulations to remove the grease applied on the wool yarn was assessed and reported. Formulation, which was incorporated with multiple surfactants, had percentage cleaning action of 33.22. The percentage cleaning action obtained for the marketed sample in this investigation was 32.17, which was marginally lesser than the herbal formulation. The possible reason behind the improved percentage cleaning action of developed formulation may be because of incorporation of two surface active agents, shikakai and liquorice in optimized concentration. Bengalgram was used in this formulation for improving viscosity. It has water-thickening potency. Hence, only a small quantity was needed to increase the viscosity of the product (0.5-1%). The higher foaming property of formulation may be due to the combination of shikakai and liquorice. Normally it is considered that forming ability of natural shampoo is not comparable with its synthetic counterpart. But the study proves that combination of natural surfactants such as shikakai and liquorice in optimized concentration can generate sufficient foam for the shampoo. This data may prove the ability of natural surfactants shikakai and liquorice in optimized concentration as the best replacement for the harsh synthetic detergents which shown in table-2 which are commonly used in majority of synthetic and their commercial herbal shampoo. The antifungal activity of developed formulations showed positive results against the tested fungal pathogen *Candida albicans*, table 04. Formulated Anti-dandruff shampoo has shown maximum inhibition, i.e. 20 mm. Marketed formulation possesses lower antifungal activity as compared with our formulation.

Formulated shampoo (F4) is more stable than the F1, F2, F3 formulations and is similar to marketed shampoo (Dove).

Table 4: *In vitro* antidandruff activity of formulations

| S. No. | Organism | Formulations | Zone of inhibition |
|--------|-------------------------|----------------------|--------------------|
| 1. | <i>Candida albicans</i> | Herbal formulation | 20mm |
| 2. | <i>Candida albicans</i> | Marketed formulation | 19mm |

The maximum antifungal activity of formulation may be because of the presence of green gram and Pomegranate which have established anti-dandruff activity. But this study may prove that ability of Green gram and Pomegranate as antidandruff agents might have improved in the presence of good surfactant i.e. optimized combination of shikakai and liquorice. When zone of inhibition was measured, formulation was having highest zone of inhibition of 20 mm, which was higher than the commercially established marketed shampoo

containing synthetic ingredients. The results from in-vitro anti-dandruff study confirm the ability of antidandruff shampoo developed from natural ingredients is the best replacement for synthetic counterpart, if formulated with best ingredients in optimized combination. Stability of formulation was checked for selected parameters after the interval of one month. There was marginal increase in pH reported for the developed formulation with increase in temperature, i.e. at 45±2°C after one month. When % cleansing action was assessed for developed formulation after one month, it was evident that % cleansing action was dropped at negligible level. Overall stability of shampoo developed from natural ingredients was good at a temperature ranging between 4 to 42°C [9, 10, 11].

Table 5: Stability studies

| Evaluation parameters | Before 1 month | After 1 month |
|-----------------------|-------------------|-------------------|
| Colour | Light brown | No Change |
| Odour | Pleasant | No Change |
| Transparency | Thick | No Change |
| pH | 6.6 ± 0.5 | 6.2 ± 0.5 |
| % Solid content | 25.75± 2% | 25.75± 2% |
| Foam volume | 98 ± 5ml | 968± 5ml |
| Surface tension | 30.68±0.5 dyne/cm | 30.68±0.5 dyne/cm |
| Wetting time | 140 sec | 140 sec |

Conclusion

A novel poly herbal anti-dandruff shampoo preparation was formulated based upon traditional knowledge and emphasis was to formulate a stable and functionally effective anti-dandruff shampoo by excluding all types of synthetic additives. The results showed that the formulation F4 of anti-dandruff herbal shampoo contains all good characters of an ideal shampoo and it was found to be harmless, more effective and economical compared to synthetic Dove anti dandruff shampoo.

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