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Formulation, development and evaluation of a poly-herbal shampoo with antidandruff property

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Abstract
Background: Most of the shampoos which are in the market are made up of synthetic detergents. Nowadays the demands of pure herbal products are increasing day by day and a large number of medicinal plants were proven to have good effects on the hair.
Aim and objective: The aim of the present study was to formulate and evaluate an herbal shampoo which having good antidandruff property.
Methods: collection and preparation of water extracts of Acacia concinna, Spindus mukorossi, Ziziphus spina, Aloe vera and Emblica officinalis and juice of Citrus Limon. Which were used for the preparation of shampoo. Seven different type of shampoo formulations were prepared and its physiochemical (visual inspection, pH, foam volume, foam type, viscosity, dirt dispersion, surface tension, percentage of solid content and cleansing action) and antidandruff properties were compared with a popular antidandruff synthetic shampoo available in the market.
Results: From the results it was showed physicochemical characteristics of the F1 formula were found to be more acceptable. The results of the formulated shampoo, showed good performance, when compared to the commercially available shampoo. The stability of the optimized formulation were evaluated and the results showed that the tested sample were stable in the shelf life.
Conclusions: When compared with synthetic one herbal shampoos are safe and mild. The formulated and optimized shampoo meets all the requirements for shampoo. Thus, the goal of the study was achieved.

Keywords: herbal shampoo, antidandruff, formulation, *Malassezia furfur*

Introduction

Shampoos are the preparations of a surfactant in a suitable form like liquid, solid or powder which when used will removes the grease and dirt on the surface of the hair, and from the shaft and from scalp, without affecting adversely the hair, scalp or the health of the user [1]. There are two kinds of shampoos are available, namely medicated shampoos and non-medicated shampoos. Dandruff is a skin disorder of the scalp. Many factors such as stress or a bad diet or extreme exposure to heat and cold may lead to this condition. The literature shows that the fungus the *Malassezia furfur* is the responsible microorganism for dandruff. One of the treatment options for Dandruff limitation is to use shampoos which are prepared with chemicals. They contain antimicrobials like ketoconazole and chemicals like selenium sulfide, zinc pyrithione [1] etc and which are harmful for hair long use. But still the synthetic shampoos are used by huge number of people neglecting the fact that they contain dangerous chemicals that effect badly on the beauty of the hair.

Baldness, white hair and alopecia are some of the examples of consequences which can be face by using synthetic shampoo [12, 13]. About 80% herbal shampoos available in the market also contain synthetic ingredients along with herbal ingredients. Commonly using synthetic ingredients are sodium lauryl sulphate, acids, sodium stearate, calcium alginate etc. SLS penetrated into the eyes as well as brain, Heart, liver and showed long-term retention in the tissues [2].

Now-a-days the demands of pure herbal products are increasing day by day and a large number of medicinal plants are proved to have good effects on the hair [3]. It is extremely difficult to prepare an herbal shampoo using a single natural material. This usually contains number of herbs, different oils etc. When compared with synthetic one herbal shampoos are safe and mild and at the same time meets all the requirements for shampoo.

The pericarp of Spindus mukorossi common name is soapnut, the Amla fruits (Emblica officinalis), and dried pods of Acacia concinna commonly known as sheekakai have been used in folklore system for cleaning the hair [5]. Spindus mukorossi and Acacia concinna contain high amount of saponins so it produces good lather when they shake with water [6]. Amla fruit is rich in vitamin C and is used in hair preparations as a promoter in hair growth and it increases the strength of hair also have antidandruff property [7]. The *Ziziphus spina-christi* is a tree indigenous to Middle East.

"Konar" plant leaves were, traditionally used for cleaning the hair. Use of powdered leaves on the hair known to blacken and lengthen the hair [8]. It is reported that the saponin glycosides present in the leaves of Ziziphus spina help in removing excess sebum without producing bad reaction and also reported to have antifungal activities [9, 10]. Lemon juice and Aloe vera [4] also act against dandruff.

Aim and Objective

The aim of the present study was to design and formulate an optimized preparation of an herbal shampoo which should have splendid antidandruff, physiochemical, pharmacological and stability characteristics.

Materials and Methods

Sample collection and extract preparation

All plant materials were collected from the local market and certified by supervisor Dr. Deepa Sreekanth. Head and shoulder Shampoo (Procter and Gamble) were collected from the local market for comparison. The extracts were prepared from the pure herbs by decoction method.

Formulation of Herbal Shampoo [14, 15]

Seven different type of shampoo formulations were prepared, which has different concentration of plant extracts as per Table.1

Table 1: Composition of Herbal Shampoo

Ingrediens	F1	F2	F3	F4	F5	F6	F7
Shikkakai extract (%)	10	_	10	10	10	10	_
Reetha extract (%)	10	10	_	10	10	10	_
Sedr extract (%)	0. 1	0.1	0. 1	_	0. 1	0. 1	0. 1
Amla extract (%)	1	1	1	1	_	1	1
Aloe extract (%)	5	5	5	5	5	_	5
Lemon juice (%)	5	5	5	5	5	5	-
Tragacanth (%)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Methyl paraben (%)	1	1	1	1	1	1	1
Propyl paraben (%)	1	1	1	1	1	1	1
Gelatin Solution qs to (mL)	100	100	100	100	100	100	100

Physiochemical Evaluation of Shampoo [14, 16, 17, 18]

Determination of pH

Prepare buffer solutions of pH 4 and 7 and calibrate pH meter MK VI using standard buffer solution. Keep different shampoo formulations and take the reading using pH meter.

Determination of Foam Formation–Shake Test

Add 5ml of 1% shampoo solution to a graduated cylinder and record the volume. The open end of the cylinder is covered and shakes for 10 times. Record the volume of contents and volume of foam after shaking.

Determination of Foam Quality and Foam Retention – Shake Test

Add 5ml of 1% shampoo solution to a graduated cylinder and record the volume. The open end of the cylinder is covered and shakes for 10 times. Record the volume of contents and foam after shaking. Record the size of bubbles and record the volume of foam at 1 minute interval for 5 minute.

Determination of Dirt Dispersion

Take 2 drops of prepared shampoo in a large stoppered and marked test tube to this add ten mL of distilled water add one drop of ink. Close the test tube with a stopper and shake it ten times. Document the amount of ink in the foam as different types like none, light, moderate, heavy etc. Formulations that keep the ink in the foam are categorized as poor quality.

Determination of Percentage of Solid Contents

Weigh a clean dry evaporating dish and record its weight. Add 4 gm of the shampoo to the dish and record the weight of evaporating dish including the weight of shampoo. Heated the dish a hot plate for evaporation of liquids. After complete evaporation weigh the dish again and record it. Calculate the weight of solid content and percentage of solids in the shampoo.

$$\% \text{ of solids} = \frac{\text{final weight of the shampoo}}{\text{Initial weight of shampoo}} * 100$$

Determination of Cleansing Action

Take 0.5 g of wool yarn wetted with grease and keep it in 20mL of water containing 1g of shampoo in a flask. Maintain the temperature of water at 32 ^{0} c. Shake the flask for 4 min at the rate of 50 times per minute. Take out the flask and collect the sample. Dry it and take the weight. Calculate the amount of grease removed by using the following equation.

DP =100 (1-T/C)

DP - % of detergency power T - Weight of test sample C - Weight of control sample

Determination of Viscosity by Using Oswald's Viscometer

Select an Oswald's viscometer clean it and dry it. Fix it vertically on to a stand and fill purified water in the viscometer. Record the time required to flow water between two points. Repeat the steps at least three times and take the average of these readings for calculation.

Stability Studies

Place 50 ml of the shampoo in the refrigerator at 5^{0}c. Place another 50 ml of the formulation at room temperature. Their appearance and physical stability were inspected for a period of 1 month. Repeat the evaluation procedure after 1 month.

Determination of antidandruff activity

Microorganism used

The test organism in the study was pure culture of Malassezia furfur. The freeze dried cultures were inoculated into broth and maintained in sabouraud dextrose agar (SDA) Slant and Stored at 4º C For further studies.

In-vitro antidandruff evaluation

In-vitro antidandruff activity was performed using the disk diffusion assay [19, 20]. Using cotton swab 5 x10^6 CFU/ml of Malassezia furfur was swabbed on the surface of the sterile SDA plates. 1 µg/ml, 5 µg/ml and 7 µg/ml of extract concentrate present in formulation F1 (optimized shampoo formulation) is soaked in sterile filter paper per disc and it is aseptically placed over the inoculated SDA plates.

Similarly, standard disc of Clotrimazole was used as the positive control for comparison of antifungal activity. The plates were incubated at 27°C for 28 hrs. After incubation the antidandruff activity was measured as inhibition zone.

Results and Discussions

Physiochemical Evaluation of Shampoo

Evaluation of physiochemical parameters was done for its organoleptic features like pH, solid content, foam volume, foam quality and retention, viscosity, dirt dispersion, surface tension and cleansing action. The results are given in the following Table.2

Table 2: Physiochemical Evaluation of Shampoo (±SD, N=6)

Formulations	pH	Percentage of solid content	Foam Volume (mL)	Foam Retention	Dirt Dispersion	Viscosity @20rpm	Cleansing Action
F1	6.11±001	25.4%±001	4±002	About 4 min	Better	65.38±001	35.64%±087
F2	6.01±008	27.4%±01	2±034	About 1 min	Moderate	66.88±013	27.59%±077
F3	6.00±006	20%±03	3±055	About 1 min	Good	65.78±032	25.29%±095
F4	6.21±003	22%±07	4±091	About 3 min	Better	66.99±043	33.34%±067
F5	6.20±007	27.4%±07	4±032	About 4 min	Good	65.21±064	32.19%±037
F6	6.15±004	20%±05	4±032	About 4 min	Good	69.55±021	33.34%±098
F7	6.03±003	21.4%±003	1±032	No foam retention	Poor	63.54±044	11.55%±038

The pH of shampoo solution was determined and the results are presented in Table 3 pH of all the shampoos are were ranged 6.00 to 6.21.It indicated that the pH of developed shampoo has comparable result with the marketed formulation indicating minimum irritation to the eyes and scalp. If the shampoo has too many solids it will be hard to wash out. The solids contents of the prepared shampoo were in a range of 27.4% to 20.00%. Product viscosity plays an important role in flow on removal from packing and spreading on application to hair and product consistency in the package. The viscosity ranges from 67 to 64 at 20 rpm. Cleaning action was tested on wool yarn in grease the results of detergency studies showed that the final formulation has considerably similar detergency ability, when compared with the marketed formulations and it was found in between 11 to 35.64%. Shampoo that causes the ink to concentrate in the foam is measured as poor quality. Dirt that stays with foam will be difficult to rinse away so it should be stay in water. Dirt that stays with foam will redeposit on the hair. All three shampoos showed similar results as the marketed one. The investigated shampoos showed similar foaming characteristics. The results obtained shows that the shampoo of formula F1 is having the good quality when compared to other formulations.

Stability Studies

The aim of stability testing was provide evidence on the quality of shampoo formulations either varies with time under the influence of variety of environmental factors like humidity, light and temperature. The stability study results are discussed in Table.3, from the results it showed that the developed formulation are table in the shelf life.

Table 3: Results of Stability Studies

Parameters	F1	F2	F3	F4	F5	F6	F7
pH	6.51	6	6.01	6.44	6.42	6.45	6.01
Foam volume	4	2	3	4	4	4	1
Dirt dispersion	Better	Moderate	Good	Better	Good	Good	Poor
Viscosity	25.38	20.88	20.78	24.99	25.29	19.55	8.54

Determination of antidandruff activity

The results of Agar Well Diffusion Assay are given in the Table.4. From the results it is clear that the extract concentrate used for the shampoo formulation has marked antidandruff potential as compared with a reference standard.

Table 4: *In-vitro* antidandruff activity of herbal extract concentrate in F

Test Organism	Zone of Inhibition (cm) ±SD,N=3			
	Herbal extract concentrate in FI (µg/mL)			Std. Clotrimazole (0.1 µg/mL)
	1 µg/mL	5 µg/mL	7 µg/mL	
M. furfur	1.0±043	1.3±045	1.6±044	1.8±033

Conclusions

The herbal antidandruff shampoo prepared in the laboratory and evaluated several parameters. The shampoo showed excellent detergent action due to the presence of ingredients like shikkakai and soapnut which helps to remove excess oil, debris (exfoliation) leaving the hair soft and lustrous. Conditioning property attributed by the ingredients amla and aloevera added in the shampoo. The antidandruff action of shampoo due to the presence of amla, lemon juice and aloevera, was proved by microbial study. From the result of all the evaluation parameters, shampoo of formula F1 showed better properties than the other formulations. As seen from the results, it is possible to formulate a completely natural poly-herbal shampoo that is better than the synthetic once.

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