ISSN: 0976-822X

Available online on www.ijcpr.com

International Journal of Current Pharmaceutical Review and Research 2022; 14(4); 76-87
Original Research Article

Formulation And Evaluation of Antidandruff Herbal Shampoo Using Petroleum Ether Extract of *Lantana camara* Linn. Leaves.

Laxmi Kant[1], Namita Arora[2]
[1]Research Scholar, Lords University, Alwar Rajasthan.
[2]Professor, Faculty of Pharmacy, Lords University, Alwar Rajasthan

Received: 26-11-2022 / Revised: 05-12-2022 / Accepted: 25-12-2022
Corresponding author: Laxmi Kant
Conflict of interest: Nil

Abstract

The objective of the present research was to formulate and evaluate anti-dandruff herbal shampoo. The herbal anti-dandruff shampoo was prepared using *Lantana camara* Linn. Leaves extract, triethanolamine lauryl sulphate, cocodiethanolamide, EGDS, jasmine oil, sodium chloride, methyl paraben, gelatin and lemon juice. Twelve formulations were prepared. Various evaluation parameters like physical appearance, determination of pH, determination of percentage of solid content, measurement of surface tension, determination of wetting time, determination of foam ability and foam stability, determination of dirt dispersion, stability study and antifungal activity were performed. Results also showed that liquid anti-dandruff herbal shampoo formulations LSF3 and LSF4 possess the characteristics of an ideal shampoo and are effective against *Malassezia furfur* MTCC 1374 and *Candida albicans* MTCC 227, the fungi responsible for dandruff in humans. It was found that LSF4 was most stable and effective amongst all formulations.

Keywords: *Lantana camara*, pH, *Malassezia furfur*, Anti-Dandruff Herbal Shampoo.

INTRODUCTION

To study and design hair preparations it is very much essential to have knowledge of hair. In addition to sebaceous glands, sweat glands, and nails, hair is an important element of the body since it serves as a protective appendage and is produced from the ectoderm of the skin.[1] when a cosmetic-product designed on behalf of the cleaning purpose of the hair and scalp, shampoos often come into bottles for ease of use. Its principal role is to remove buildup of sebum, dead skin cells from the scalp, and other residues from hair care products. Many remedies are available for the management of dandruff, like anti-dandruff shampoos, ointments and lotions, house hold remedies, etc., out of which antidandruff shampoos are the most popular that are based on agents that are antimicrobial in nature. These formulations have a combination of active herbal components and conventional surfactants. Extracts from Tulsi, citrus lemon, henna, geranium, neem, ashwagandha, arnica, walnut, etc. are only few of the many beneficial extracts utilized in the composition of antidandruff shampoos.[2]

The objective of the present research was to formulate and evaluate anti-dandruff herbal shampoo using *Lantana camara* Linn. leaves extract.

MATERIAL AND METHODOLOGY

Collection of Plant Material

Lantana camara plant was collected from rural area of Harmada, Jaipur, Rajasthan.

Extraction Process of the Plant Material [3]

1) Plant material (leaves) was collected.
2) Rinse with distil water and dried at room temperature in shade.

3) Chopped into small pieces and coarse powder was prepared. Extraction was done using water, methanol, petroleum ether and toluene.
4) Extract was filtered and filtrate was collected.
5) Filtrate was evaporated to obtain concentrated extract.
6) Different Phytochemical tests were carried out.

Formulation of Liquid Anti Dandruff Herbal Shampoo

Plant extract's preparation: 30 grams of *Lantana camara* Linn. leaves powder has been taken into Soxhlet extractor furthermore extracted by utilizing Petroleum ether (50-60) for 72 hours. The solvent recovered by distillation method and concentrate the extract. Extract was concentrated using a vacuum rotary evaporator at 40^0C. The percentage of the extract that was recovered as a yield was 8.5% weight by weight. Dried extract has been dissolved into the castor oil (10% w/v) and was used for formulation of liquid anti dandruff herbal shampoo.

Preparation Liquid Anti Dandruff Herbal Shampoo

a) Preparation of LSF1 and LSF2

The plant extract was mixed with other ingredients to obtain two shampoo formulations (LSF1 and LSF2) as given in Table-1. Triethanolamine lauryl sulfate was added in the same ratio in both formulations whereas cocodiethanolamide was added in different proportion. Triethanolamine lauryl sulfate was used as a foaming agent and shampoo base. Cocodiethanolamide is a non-ionic surfactant made from coconut oil. It is a yellowish-brown liquid used as a foam booster and viscosity builder. EGDS (Ethylene glycol distearate) was added to get a pearlescent effect. EGDS acts as an opacifying and pearlizing agent as well as a thickener. Essential oil of jasmine was added to the shampoo to give it a lovely fragrance. A pinch of sodium chloride was also added to increase the viscosity. Finally, the formulation was made to 100 ml with water which acts as a diluent.

Table 1: Formulation of LSF1 and LSF2

S. No.	Ingredients	Formulation (100 ml)	
		LSF1	LSF2
1.	*Lantana camara* leaf extract	20 ml	25 ml
2.	Triethanolamine lauryl sulphate	5 ml	5 ml
3.	Cocodiethanolamide	2 ml	3 ml
4.	EGDS	2 g	1 g
5.	Water	33 ml	22 ml
6.	Jasmine oil	q.s.	q.s.
7.	Sodium chloride	q.s.	q.s.

b) Preparation of LSF3 and LSF4

Plant extracts were mixed in different proportions along with other ingredients to obtain two shampoo formulations (LSF3 and LSF4) as given in Table-2. Triethanol amine lauryl sulfate was added in the same ratio in both formulations whereas cocodiethanolamide was added in different proportions. Triethanolamine lauryl sulfate was used as a foaming agent and shampoo base. Cocodiethanolamide is a non-ionic surfactant made from coconut oil. It is a yellowish-brown liquid used like a foam booster and viscosities enhancer. Essential oil of jasmine was added to the shampoo to give it a lovely fragrance. A pinch of sodium chloride was also additional to enhance shampoo's viscosity. Finally, the formulation was made to 100 ml with water which is a diluent.

Table 2: Formulation of LSF3 and LSF4

S. No.	Ingredients	Formulation (100 ml)	
		LSF3	LSF4
1	*Lantana camara* leaf extract	20 ml	20 ml
2	Triethanolamine lauryl sulphate	5 ml	5 ml
3	Cocodiethanolamide	4 ml	5 ml
4	Water	21ml	20 ml
5	Jasmine oil	q.s.	q.s.
6	Sodium chloride	q.s.	q.s.

c) Preparation of LSF5 and LSF6

LSF5 and LSF6 Preparation were prepared by mixing different proportions of plant extracts with gelatin, lemon juice and water. Gelatin was added to water and mixed well on a magnetic stirrer before incorporating into the formula. 1ml of lemon juice was added to plant extracts. Lemon juice can act both as a pH modifier and preservative. Both solutions were mixed well and 0.1% (100mg) of methyl-paraben used in the form of preservative. Jasmine essential oil was added for fragrance.

Table 3: Formulation of LSF5 and LSF6

S. No.	Ingredients	Formulation (100 ml)	
		LSF5	LSF6
1	*Lantana camara* leaf extract	30 ml	25 ml
2	Gelatin	1%	2%
3	Lemon juice	1 ml	1 ml
4	Water	29 ml	19 ml
5	Methyl paraben	0.1 % (100 mg)	0.1 % (100 mg)
6	Jasmine oil	q.s.	q.s.

d) Preparation of LSF7 and LSF8

The formulations LSF7 and LSF8 were prepared by mixing different proportions of plant extracts with guar gum, glycerin and distilled water. Guar gum was added to water and mixed well on a magnetic stirrer. The plant extracts were mixed with glycerin and was incorporated with guar gum solution. Guar gum hydrates rapidly to produce highly viscous solutions and thus acts as viscosity builder. Glycerin was utilized as a conditioning manager for the hair in addition to its role as a humectant, which prevented the shampoo from loosing its moisture content too quickly. 0.05% (50 mg) of methyl paraben and 35 mg of sodium benzoate were added as preservative. Jasmine essential oil was added for imparting fragrance.

Table 4: Formulation of LSF7 and LSF8

S. No.	Ingredients	Formulation (100 ml)	
		LSF7	LSF8
1	*Lantana camara* leaf extract	30 ml	30 ml
2	Guar gum	1 g	0.5g
3	Glycerin	1 ml	1 ml
4	Water	19 ml	19 ml
5	Methyl paraben	0.05% (50 mg)	0.05% (50 mg)
6	Sodium benzoate	35 mg	35 mg
7	Jasmine oil	q.s.	q.s.

e) Preparation of LSF9, LSF10, LSF 11 and LSF12

The formulations LSF9, LSF10, LSF11 and LSF12 were prepared by mixing same proportion of plant extracts with four different surfactants (SLS, Sodium Lauryl Ether Sulfate, Ammonium lauryl sulfate and Cocobetaine) together with same ratio of Cocodiethanolamide and water. SLS known as anionic surfactant which acts as a foaming and thickening agent. Sodium lauryl ether sulfate (SLES) is also an anionic surfactant acting as a foaming agent. Ammonium lauryl sulfate functions as a foaming and emulsifying agent. Cocamidopropyl betaine (cocobetaine) is a mild surfactant derived from coconut oil. Jasmine essential oil was added for fragrance and sodium chloride as thickening agent.

Table 5: Formulation of LSF9, LSF10, LSF11 and LSF12

S. No.	Ingredients	Formulation (100 ml)			
		LSF9	LSF10	LSF11	LSF12
1	*Lantana camara* leaf extract	25ml	25ml	25ml	25ml
2	Chemical surfactants	SLS (5g)	SLES (5ml)	Ammonium lauryl sulphate(5ml)	Cocobetaine (5 ml)
3	Cocodiethanolamide	2ml	2ml	2ml	2ml
4	Water	18ml	18ml	18ml	18ml
5	Jasmine oil	q.s.	q.s.	q.s.	q.s.
6	Sodium chloride	q.s.	q.s.	q.s.	q.s.

Evaluations parameters of Liquid Anti Dandruff Herbal Shampoo

a) Physical appearance / Visual inspection [4]

The created formulations were tested for its colour, transparency, odour.

b) Determination of pH [5]

A pH meter was used to determine the value of the shampoo solution's pH at room temperature (10% volume/volume in distilled water).

c) Determination of percentage of solid contents [5]

A sample amounting to four grams of shampoo has been measured out and then put in a dish designed for the evaporation of dry substances. For verification purposes, the combined dish and shampoo weight was recorded. The liquid shampoo was put in a dish and heated until it evaporated. The following table-8 displays the findings of a weight and percentage analysis performed on the solid components of shampoo after it had dried completely.

d) Measurement of Surface Tension [6]

It was made into a shampoo solution with a 10% weight-to-volume ratio in distilled water and the surface tension was measured using stalagmometer at room temperature.

e) Determination of Wetting Time [7]

Discs made from a canvas paper measuring 1 inch in diameter and weighing an average of 0.44 grams was created. A shampoo solution of 1% volume/volume (v/v) was made, and the disc's smooth side was put on top of it. After timing how long it took in favour of the disc to commence dipping, called the wetting time.

f) Determination of Foam Ability and Foam Stability [7]

The shaking of the cylinder method was used in order to conduct the evaluation of the capacity for foaming. We measured out 50 ml of 1% shampoo solution into a 250 ml graduated cylinder. The hand covered it

and shook it ten times. The table-11 displays the total volume of foam produced after vigorous shaking for 1 minute. The amount of foam that produced after one minute and four minutes of shaking was recorded, and the resulting data and observations are shown in the table below.

g) Determination of Dirt-dispersion [8] An amount of 10 milliliters of distilled water was mixed with 2 drops of the shampoo- mixture in a big test-tube. The solution was spiked with a single drop of Indian ink. After that, we put the cap on the test tube and gave it a good shake for10 seconds. There were four distinct degrees of foam ink used for this study: none, light, moderate, and heavy.

h) Stability Study [8] The shampoo formulation underwent a stability testing at 25-30^{0}C for a period of 3 Months. Stability was tested in terms of parameters like physical appearance, colour and odour.

i) Anti-Fungal Activity [7] The antifungal activity of formulated Liquid Anti Dandruff Herbal Shampoo was assessed at two different concentrations as 50 mg/ml and 100 mg/ml by Cup plate/ Cylinder-plate method. The fungal strains used were *Candida albicans* MTCC 227 and *Malassezia furfur* MTCC 1374. The positive control was ketoconazole at 1 mg/ml concentration. Negative control was shampoo base with water at 100 mg/ml**.**

RESULT ANS DISCUSSION

A. Physical appearance / Visual inspection: All formulations were brownish in color with different gradations and opaque in nature. The market sample was green in color. The results of visual inspection are showed in given below table no. 6.

Table 6: Physical appearance / Visual inspection

S. No.	Formulation of Shampoo	Evaluation Parameters		
		Colour	Transparency	Odour
1.	LSF1	Light Brown	Opaque	Pleasant
2.	LSF2	Brown	Opaque	Pleasant
3.	LSF3	Brown	Opaque	Pleasant
4.	LSF4	Brown	Opaque	Pleasant
5.	LSF5	Brown	Opaque	Pleasant
6.	LSF6	Light Brown	Opaque	Pleasant
7.	LSF7	Brown	Opaque	Pleasant
8.	LSF8	Brown	Opaque	Pleasant
9.	LSF9	Brown	Opaque	Pleasant
10.	LSF10	Brown	Opaque	Pleasant
11.	LSF11	Brown	Opaque	Pleasant
12.	LSF12	Brown	Opaque	Pleasant
13.	Marketed Ayur shampoo	Green	Opaque	Pleasant

The light brown colour for LSF1 is due to comparatively higher amount of EGDS which gives a pearlescent effect. LSF6 also possess a lighter shade. All others exhibited a natural dark brown colouration. There was no need to add any synthetic colorant to the final formulations, because they already have a natural colouration. All the formulations were opaque with a pleasant smell. The marketed sample was green in colour, opaque with a pleasant smell.

B. pH Determination

A pH meter was used to determine the value of the shampoo solution's pH at room temperature (10% volume/volume in distilled water).

Table 7: pH of antidandruff herbal shampoo

S. No.	Formulation of Shampoo	pH
1.	LSF1	7.12 ± 0.07
2.	LSF2	7.23 ± 0.06
3.	LSF3	7.36 ± 0.03
4.	LSF4	7.12 ± 0.04
5.	LSF5	5.19 ± 0.05
6.	LSF6	4.56 ± 0.05
7.	LSF7	5.12 ± 0.07
8.	LSF8	5.67 ± 0.04
9.	LSF9	8.42 ± 0.06
10.	LSF10	8.65 ± 0.04
11.	LSF11	8.12 ± 0.05
12.	LSF12	8.38 ± 0.07
13.	Marketed Ayur shampoo	6.22 ± 0.08

The formulations LSF1, LSF2, LSF3 and LSF4 showed a pH slightly above neutral value and the pH range was 7.12 to 7.36, whereas the formulations LSF5, LSF6, LSF7 and LSF8 have an acidic pH and the pH range was 4.56 to 5.67. The formulations LF9, LF10, LSF11 and LSF12 were found to have an alkaline pH in the range of 8.16 to 8.65. This can be made acidic by the addition of citric acid or lemon juice. The pH of marketed shampoo was 6.22± 0.08.

C. Determination of % Solid Contents

A sample amounting to four grams of shampoo has been measured out and then put in a dish designed for the evaporation of dry substances. For verification purposes, the combined dish and shampoo weight was recorded. The liquid shampoo was put in a dish and heated until it evaporated. The following table displays the findings of a weight and percentage analysis performed on the solid components of shampoo after it had dried completely.

Table 8: % Solid contents of herbal shampoo

S. No.	Formulation of Shampoo	% Solid contents
1.	LSF1	7.14 ± 0.03
2.	LSF2	7.16 ± 0.02
3.	LSF3	7.85± 0.05
4.	LSF4	8.10 ± 0.04
5.	LSF5	1.36 ± 0.05
6.	LSF6	1.25± 0.03
7.	LSF7	2.81 ± 0.05
8.	LSF8	1.75 ± 0.04
9.	LSF9	8.15 ± 0.03
10.	LSF10	5.95 ± 0.06
11.	LSF11	5.09 ± 0.04
12.	LSF12	5.71 ± 0.05
13.	Marketed Ayur shampoo	9.43 ± 0.03

The percentage of solid contents was almost similar for LSF1 (7.14 ± 0.03) and LSF2 (7.16 ± 0.02). The formulations LSF3 (7.85± 0.05) and LSF4 (8.10 ± 0.04) showed slight variation in percentage of solid contents and the highest percentage of solid contents in LSF9 (8.15 ± 0.03). The formulations LSF5 (1.36 ± 0.05), LSF6 (1.25±0.03), LSF7 (2.81 ± 0.05) and LSF8 (1.75 ± 0.04) were with the lowest percentage of solid contents when compared with other eight formulations. This is

because gum acacia and gelatin behaved as just suspending agents and could not contribute to solid contents. Among the formulations LSF9 (8.15 ± 0.03), LSF10 (5.95 ± 0.06), LSF11 (5.09 ±0.04) and LSF12 (5.71 ± 0.05) percentage of solid contents presented the highest value in LSF9 (8.15 ± 0.03), Temperature.

which was also the maximum value recorded. Marketed shampoo showed 9.43 ± 0.03 % of solid contents.

D. Measurement of Surface Tension

It was made into a shampoo solution with a 10% weight-to-volume ratio in distilled water and the surface tension was measured using stalagmometer at room

Table 9: Surface tension of herbal shampoo

S. No.	Formulation of Shampoo	Surface Tension (Dyne/cm)
1.	LSF1	34.25 ± 0.04
2.	LSF2	33.85 ± 0.05
3.	LSF3	38.15± 0.04
4.	LSF4	37.10 ± 0.02
5.	LSF5	63.25± 0.05
6.	LSF6	61.24± 0.06
7.	LSF7	62.30 ± 0.06
8.	LSF8	61.57 ± 0.07
9.	LSF9	38.05 ± 0.04
10.	LSF10	30.20 ± 0.03
11.	LSF11	37.85± 0.05
12.	LSF12	36.10 ± 0.05
13.	Marketed Ayur shampoo	38.64 ± 0.06

Surface tension exhibited much variation among the formulations. The surface tension of prepared shampoo was found in the range of 30.20 ± 0.03 to 63.25± 0.05 dyne/cm. In the twelve formulations, surface tension was found to be high in four formulations without any synthetic surfactants, LSF5, LSF6, LSF7 and LSF8 and the highest value was observed in LSF5 (63.25± 0.05). The lowest value was recorded in LSF10 (30.20± 0.03). This means SLES when combined with cocodiethanolamide was more efficient in reducing the surface tension of water when compared with other synthetic surfactants.

D. Determination of Wetting Time

Discs made from a canvas paper measuring 1 inch in diameter and weighing an average of 0.44 grams was created. A shampoo solution of 1% volume/volume (v/v) was made, and the disc's smooth side was put on top of it. After timing how long it took in favour of the disc to commence dipping, called the wetting time.

Table 10: Wetting time of herbal shampoo

S. No.	Formulation of Shampoo	Wetting time (Sec.)
1.	LSF1	157±3
2.	LSF2	155±2
3.	LSF3	162±3
4.	LSF4	160±2
5.	LSF5	168±4
6.	LSF6	174±3
7.	LSF7	166±2
8.	LSF8	162±3
9.	LSF9	158±2
10.	LSF10	159±3
11.	LSF11	161±4
12.	LSF12	163±2
13.	Marketed Ayur shampoo	140±4

The maximum wetting time was observed in LSF6 (174±3 sec) and it's possible that this is because there aren't any synthetic surfactants present. The lowest value was seen in LSF2 (155±2 sec) which suggests that a combination of triethanolamine lauryl sulphate and cocodiethanolamide in a particular proportion can effectively reduce the wetting time during hair wash. The marketed shampoo showed the wetting time was 140±4 sec.

E. Determination of Foam Ability and Foam Stability

The shaking of the cylinder method was used in order to conduct the evaluation of the capacity for foaming. We measured out 50 ml of 1% shampoo solution into a 250 ml graduated cylinder. The hand covered it and shook it ten times. The following table displays the total volume of foam produced after vigorous shaking for 1 minute. The amount of foam that produced after one minute and four minutes of shaking was recorded, and the resulting data and observations are shown in the table no. 11 below.

Table 11: Foam ability and foam stability of herbal shampoo

S. No.	Formulation of Shampoo	Foam ability	Foam Stability
1.	LSF1	Good Foam	77.57 ± 1.2
2.	LSF2	Good Foam	80.25 ± 1.3
3.	LSF3	Good Foam	118.25 ± 1.4
4.	LSF4	Good Foam	121.60 ± 1.5
5.	LSF5	Nil	Nil
6.	LSF6	Nil	Nil
7.	LSF7	Nil	Nil
8.	LSF8	Nil	Nil
9.	LSF9	Good Foam	114.12± 1.4
10.	LSF10	Good Foam	110.62 ± 1.7
11.	LSF11	Good Foam	63.57 ± 1.3
12.	LSF12	Good Foam	100.67 ± 1.4
13.	Marketed Ayur shampoo	Good Foam	125.60 ± 1.4

The absence of foaming in the formulations LSF5, LSF6, LSF7 and LSF8 may be due to lack of synthetic surfactants because plant extracts alone may not exhibit vigorous foaming property like the surfactants. Moreover, the addition of gum acacia and gelatin might have interfered in its foaming ability. Highest foaming capacity was exhibited by LSF4 (121.60 ± 1.5ml) which is a combination of Triethanolamine lauryl sulphate and Cocodiethanolamide. The lowest foaming volume was observed in LSF11 (63.57±1.3ml), which contained ammonium lauryl sulphate and Cocodiethanolamide as the synthetic ingredients.

F. Determination of Dirt-dispersion

An amount of 10 milliliters of distilled water was mixed with 2 drops of the shampoo- mixture in a big test-tube. The solution was spiked with a single drop of Indian ink. After that, we put the cap on the test tube and gave it a good shake for 10 seconds. There were four distinct degrees of foam ink used for this study: none, light, moderate, and heavy.

Table 12: Dirt Dispersion in herbal shampoo

S. No.	Formulation of Shampoo	Dirt Dispersion
1.	LSF1	Moderate
2.	LSF2	Moderate
3.	LSF3	Moderate
4.	LSF4	Moderate
5.	LSF5	Heavy
6.	LSF6	Heavy
7.	LSF7	Heavy
8.	LSF8	Heavy
9.	LSF9	Moderate
10.	LSF10	Moderate
11.	LSF11	Moderate
12.	LSF12	Moderate
13.	Marketed Ayur shampoo	Light

The ability for the dirt dispersion of eight prepared formulations (LSF1, LSF2, LSF3, LSF4, LSF9, LSF10, LSF11 and LSF12) showed moderate activity in dirt dispersion test. LSF5, LSF6, LSF7 and LSF8 demonstrated heavy activity in dirt dispersion test may be because of the absence of synthetic surfactants in them. The marketed shampoo showed the light activity in the dirt dispersion evaluation test.

G. Stability Studies

The shampoo formulation underwent a stability testing at 25-30 degrees Celsius, the norm for most rooms for a period of 3 Months. Stability was tested in terms of parameters like physical appearance, colour and odour.

Table 13: Stability studies of herbal shampoo

S. No.	Formulation of Shampoo	Stability studies		
		Colour	Transparency	Odour
1.	LSF1	Poor Stable	Poor Stable	Poor Stable
2.	LSF2	Poor Stable	Poor Stable	Poor Stable
3.	LSF3	Stable	Stable	Stable
4.	LSF4	Stable	Stable	Stable
5.	LSF5	Poor Stable	Poor Stable	Poor Stable
6.	LSF6	Poor Stable	Poor Stable	Poor Stable
7.	LSF7	Poor Stable	Poor Stable	Poor Stable
8.	LSF8	Poor Stable	Poor Stable	Poor Stable
9.	LSF9	Stable	Stable	Stable
10.	LSF10	Stable	Stable	Stable
11.	LSF11	Stable	Stable	Stable
12.	LSF12	Stable	Stable	Stable
13.	Marketed Ayur shampoo	Stable	Stable	Stable

A three-month stability assessment was conducted and the formulations LSF3, LSF4, LSF9, LSF10, LSF11 and LSF12 were found to be stable. Precipitation was noticed in LSF1 and LSF2. The formulations LSF5, LSF6, LSF7 and LSF8 were not stable in terms of contamination and stability could be achieved only by the addition of preservatives like methyl paraben and sodium benzoate. A major disadvantage of the natural formulations is their poor stability. Microbial growth was observed in these formulations even though 0.05% of methyl paraben was added as preservative in all of them. In the case of LSF5 and LSF6, the concentration of methyl paraben was increased to 0.1% and it could inhibit further microbial attack. But in the case of LSF7 and LSF8, 35 mg of sodium benzoate was added in addition

to 0.05% of methyl paraben. The other formulations did not have any microbial attack. In the case of LSF1 and LSF2 precipitation was noticed, which might be due to the addition of EGDS in the powder form.

H. Anti-Fungal Activity

The antifungal activity of formulated Liquid Anti Dandruff Herbal Shampoo was assessed at two different concentrations as 50 mg/ml and 100 mg/ml by Cup- plate/Cylinder-plate method. The fungal strains used were *Candida albicans* MTCC 227 and *Malassezia furfur* MTCC 1374. The positive control was ketoconazole at 1mg/ml concentration. Negative control was shampoo base with water at conc. of 100 mg/ml. The results are summarized in given table-14 and table-15.

Table 14: Anti-Fungal Activity against *Candida albicans* MTCC 227

S. No.	Formulation of Shampoo	Zone of inhibition (Diameter in mm)		
		Conc. (50mg/ml)	Conc. (100mg/ml)	Negative control (Shampoo base)
1.	LSF1	-	10.3 ± 0.58 mm	10.3 ± 0.58 mm
2.	LSF2	-	10.7 ± 0.58 mm	10.0 ± 1 mm
3.	LSF3	-	14.7 ± 0.58 mm	10.0 ± 1 mm
4.	LSF4	-	11.3 ± 0.58 mm	10.0 ±1 mm
5.	LSF5	-	-	-
6.	LSF6	-	-	-
7.	LSF7	-	-	-
8.	LSF8	-	-	-
9.	LSF9	-	10.3 ± 0.58 mm	9.7 ± 0.58 mm
10.	LSF10	-	-	-
11.	LSF11	-	11.3 ± 0.58 mm	9.7 ± 0.58 mm
12.	LSF12	-	-	-
13.	Positive control: Ketoconazole (1mg/ml)	31.0 ± 0.71 mm		






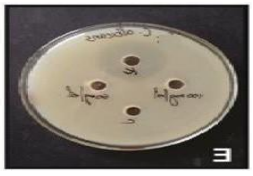

Figure 1: Antifungal activity of Liquid Anti Dandruff Herbal Shampoo formulations (50 mg/ml, 100 mg/ml) versus *Candida albicans* MTCC 227 (A) LSF1 (B) LSF2 (C) LSF3 (D) LSF4 (E) LSF5 (F) LSF6. K -Positive control, C - Shampoo base

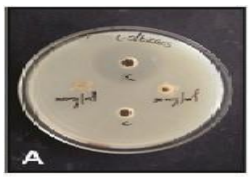




Figure 2: Antifungal activity of Liquid Anti Dandruff Herbal Shampoo formulations (50 mg/ml and 100 mg/ml) versus *Candida albicans* MTCC 227 (A) LSF7 (B) LSF8 (C) LSF9 (D) LSF10 (E) LSF11 (F) LSF12. K -Positive control, C -Shampoo base.

Table 15: Antifungal activity of Liquid Anti Dandruff Herbal Shampoo on *Malassezia furfur* MTCC 1374

S. No.	Liquid Anti Dandruff Herbal Shampoo	Zone of inhibition (Diameter in mm)	
		Conc.(200mg/ml)	Conc. (250 mg/ml)
1.	LSF1	11.7± 0.58 mm	11.7± 1.2 mm
2.	LSF2	11± 1 mm	12.7± 1.5 mm
3.	LSF3	11.3± 0.58 mm	12± 1 mm
4.	LSF4	13.3± 1.2 mm	14± 1 mm
5.	Positive control: Ketoconazole (1mg/ml)	34± 0.71 mm	

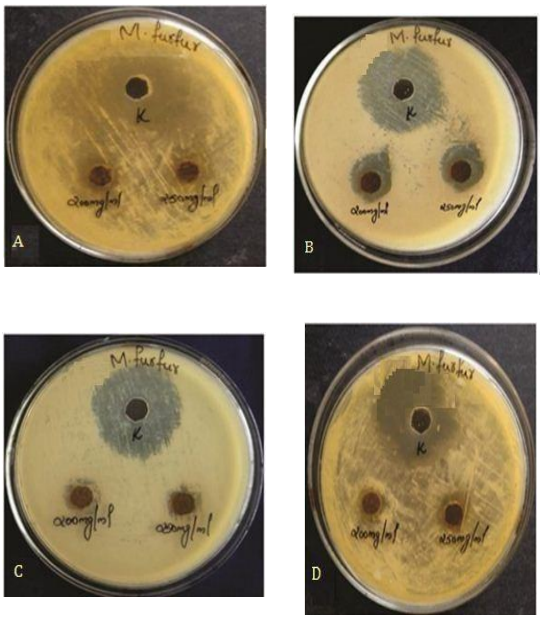

Figure 3: Antifungal activity of Liquid Anti Dandruff Herbal Shampoo formulations (Conc. 200 mg/ml, 250 mg/ml) versus *Malassezia furfur* MTCC 1374 (A) LSF1 (B) LSF2(C) LSF3 (D) LSF4, K -Positive control

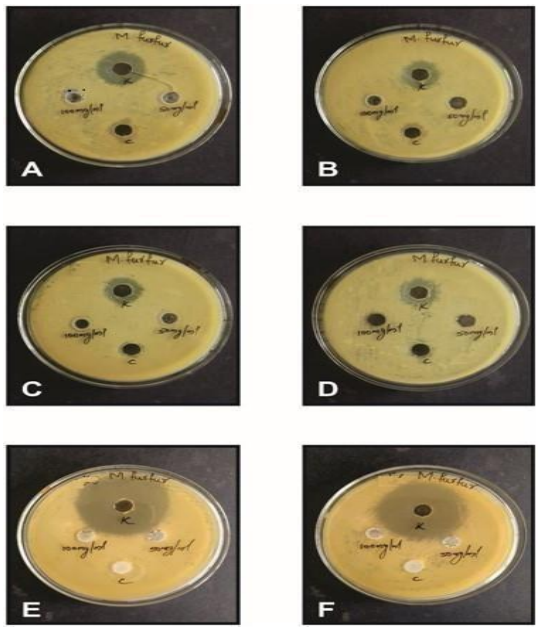

Figure 4: Antifungal activity of Liquid Anti Dandruff Herbal Shampoo formulations was not found at 50 mg/ml, 100 mg/ml concentration versus *Malassezia furfur* MTCC 1374, K - Positive control, C - Shampoo base

CONCLUSION

The objective of the present research work was to develop a liquid herbal antidandruff shampoo of *Lantana camara* Linn. leaves extract and evaluate it for the antifungal activities using the Cup-plate/Cylinder- plate method, which is based on the concept of a zone of inhibition. Antifungal activity of liquid anti-dandruff shampoo formulations containing petroleum ether extract of *Lantana camara* Linn. leaves was examined against *Malassezia furfur* MTCC1374 and *Candida albicans* MTCC227. Results showed that petroleum ether extract and the liquid anti-dandruff herbal shampoo formulations containing petroleum ether extract of *Lantana camara* Linn. leaves were effective against dandruff- causing *Malassezia furfur* MTCC 1374 and *Candida albicans* MTCC 227.

Results also showed that liquid anti-dandruff herbal shampoo formulations LSF3 and LSF4 possess the characteristics of an ideal shampoo and are effective against *Malassezia furfur* MTCC 1374 and *Candida albicans* MTCC 227, the fungi responsible for dandruff in humans. It was found that LSF4 was most stable and effective amongst all formulations. The present study was aimed at formulating a liquid anti-dandruff herbal shampoo that was stable and functionally effective against dandruff. The prepared herbal shampoo showed good activity against the dandruff causing fungal strains *Malassezia furfur* MTCC 1374 and *Candida albicans* MTCC 227.Therefore, it can be concluded that its use in traditional medicine is justifiable, and it might therefore be included to the possible list of herbal anti- dandruff agents.

REFERENCES

1. Ebling FG. The Biology of Hair. Clinical Dermatology. 1997; 5:467-481.
2. Doughari JH, Manzara S. African Journal of Microbiology Research. 2008; 2:67-72.
3. Kokate CK. Practical Pharmacognosy. Vallabh Prakashan, New Delhi.1994.107-111, 124-125.
4. Aghel N, Moghimipour B, Dana RA. Formulation of a herbal shampoo using total saponins of Acanthophyllum squarrosum. Iran j pharm Res., 2007; 6(3): 167-72.
5. Badi KA, Khan SA. Formulation, evaluation and comparison of the herbal shampoo with the commercial shampoo. Beni-Suef Univ J Basic Appl Sci., 2014; 3: 301-5.
6. Mainkar AR, Jolly CI. Evaluation of commercial herbal shampoos. Int J Cosmet Sci., 2000; 22: 385-91.
7. Klein K. Evaluation of shampoo foam. Cosmet Toilet Mag., 2004; 119(10): 32-5.
8. Ali HS, Kadhim RB. Formulation and evaluation of herbal shampoo from Ziziphus spina leaves extract, IJRAP, 2011; 2(6): 1802-6.