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Research article

# Formulation and evaluation of antifungal hair gel containing hydroalcoholic extract of *fagonia schweinfurthii* hadidi

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## ABSTRACT

Nature is one the major source of drugs in medical field. The whole plant or a part of plant and its extract can be used to treat number of diseases in human. *Fagonia schweinfurthii* hadidi is herb found in desert which has great medicinal values. The aim of this study was to find the antifungal activity of Hydroalcoholic extract of *Fagonia schweinfurthii* hadidi and formulate herbal cream. In this study Hydroalcoholic extract of *Fagonia schweinfurthii* hadidi used as antifungal agent. Antifungal study was carried out by determination of minimum inhibitory concentration (MIC) and zone of inhibition against *Candida albicans* and *Malassezia furfur*. Nine formulations were prepared using factorial design. Aloe Vera, Carbopol 934, HPMC, PEG, Methyl paraben and Triethanolamine were used to prepare gel formulation. MIC against *C. albicans* and *M. furfur* was found to be 100 µg/ml and 90 µg/ml respectively while zone of inhibition was found to be 39 ± 1.7 mm and 42± 1.2 mm respectively of Hydroalcoholic extract of *F. schweinfurthii* hadidi. Viscosity, spreading coefficient and pH of optimized F5 formulation were found to be 14453±32 cp, 23.89±6 gm.cm/sec and 6.9 respectively. Zone of inhibition shows that it has optimum antifungal activity against *C. albicans* (35 ± 1.2 mm) and *M. furfur* (40± 1.4 mm). Antifungal study reveals that F5 formulation had potent antifungal activity against *C. albicans* and *M. furfur*.

**Keywords:** Antifungals, *Candida albicans*, Herbal gel, *Malassezia furfur*

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## INTRODUCTION

For many decades plants and its extract have been used for treatment of various diseases of human. These natural sources contain number of active compounds including various anti microbials [1]. There are number of synthetic chemical compound which shows antimicrobial potential, but main problem is side effect and resistance against bacteria and fungi, so natural compound draw attention and produced interest in scientist to use natural anti-microbial agents. Traditionally huge numbers of plants and extract are used to treat various skin disorder including bacterial and fungal infection [2]. Dandruff is common scalp problem related to skin. This condition may produce itches and flakes on scalp. The serious problem of dandruff may lead to serious complications like psoriasis, excessive drying of skin and seborrheic dermatitis [3].

There are number of cosmetic and medicinal preparations available in market which contains synthetic chemicals like salicylic acid, imidazole derivatives, selenium sulphate, steroids etc. for management of scalp problem. But due to some poor clinical efficacy and unable to prevent recurrence of this clinical condition it is necessary to identify and develop novel natural antifungals, which could have potential benefits to the society [4]. There are several studies reported that plant part and plant extract can be used to treat dandruff like *Rosmarinus officinalis* [5], *Salvia officinalis* L. [6], *Mentha piperita* [7], *Punica granatum* [8] etc.

Aloe vera is belongs to family Liliaceae which is stem less plant. It is cactus like plant that grows in hot and dry climate. In literature it was found that it has wonderful medicinal values. It can be used in obesity, diabetes, osteoarthritis, skin conditions such as acne, dandruff, wound healing and many others. Due to these properties it is used in various herbal dosages forms and cosmetic formulations [9].

*Fagonia schweinfurthii* hadidi is herb which is widely distributed in dry area of western India like Rajasthan. It's also

distributed in Pakistan, Iran, Somalia and tropical Africa. It is belonging to Zygophylaceae family. Traditionally plants belong to species Fagonia are used in inflammation, allergy wound healing and skin disorder [10,11,12]. Alqasoumi et al. claimed the anti-inflammatory and wound healing activity. Quresh et al. reported that traditionally the powder of whole plant used in boils and skin eruptions [13]. Puri et al. claimed the anti-histaminic and anti-fungal activity of aqueous extract of *Fagonia schweinfurthii* hadidi [14,15].

*Malassezia furfur* is most suspected fungus which play major role in dandruff condition [3]. Also, *Candida albicans* is fungus which can produce skin infection and commonly used as model organism for fungal pathogen. The aim of present study was to develop and evaluate antidandruff gel which contains hydro alcoholic (HA) extract of fagonia and Aloe vera.

## MATERIALS AND METHOD

### Plant Material

*Fagonia schweinfurthii* hadidi was collected from Jodhpur district (Rajasthan, India). Plant was authentified from Botanical Survey of India (Jodhpur). Other plant Aloe vera was collected from local garden of Institute and also authentified from BSI, Jodhpur.

### Preparation of plant extract

Fresh shaded dried plant *Fagonia schweinfurthii hadidi* was shade dried and grounded to moderately coarse powder. Soxhletion method was used for extraction. 40 gm dried powder was extracted using of 50:50 ratio of water and ethanol. 45 µm membrane filter was used for filtration of extract then filtrate was dried through evaporation. Fresh Aloe vera juice was collected from leaf of plant.

### Test Microorganisms and Culture Media

There were two microbial stains belongs to fungi used for study. First was most suspected which is major cause of dandruff is *Malassezia furfur* (MTCC 1374) and second one is model organism for fungal infection that is *Candida albicans* (MTCC 183). Both the fugal strain was procured from MTCC (Microbial Type Culture Collection) Chandigarh, India. Sabouraud Dextrose Broth (Hi-Media) was used for growth of both the strains. Both the fungal strains were incubated at 28° C for 24 hrs. The microbial load was adjusted to $10^7$ CFU/ml during anti-microbial study.

### Determination of Minimum Inhibitory Concentration (MIC) and Zone of Inhibition of HA Extract

Antimicrobial study of HA extract of *Fagonia schweinfurthii* hadidi was performed by determining the MIC and Zone of Inhibition. Turbidity method for determination of MIC and Cup-plate method for determination of Zone of Inhibition were used [16].

### Formulation of Herbal Gel

$3^2$ factorial design was used for formulation of herbal gel, in which two components (Carbopol 934 and HPMC) were selected at three levels. Various formulation designs were shown in Table 1. Measured quantity of Methyl paraben and Triethanolamine were dissolve in 20 ml of water in beaker with continuous stirring. Then measured quantity of carbopol 934 and HPMC was added slowly to above beaker with continuous stirring and allowed it for 2 hrs to hydrate (Phase I). Measured quantity of HA extract and Aloe vera were dissolve in poly ethylene glycol (PEG) (Phase II). Then second phase was mixed slowly to the first phase with stirring. The final weight was adjusted to 50 gm by addition of water [17].

**Table 1:** Various Formulations of Hair Gel using Factorial design

| Ingredients | Formulation code | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F1 | F 2 | F 3 | F 4 | F 5 | F 6 | F 7 | F 8 | F 9 |
| HA Extract (gm) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Aloe vera Extarct (gm) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Carbopol 934 (gm) | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| HPMC (gm) | 0.25 | 0.25 | 0.25 | 0.5 | 0.5 | 0.5 | 0.75 | 0.75 | 0.75 |
| PEG (ml) | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Methyl paraben (gm) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Triethanolamine (ml) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Water | q.s. to 50 gm | q.s. to 50 gm | q.s. to 50 gm | q.s. to 50 gm | q.s. to 50 gm | q.s. to 50 gm | q.s. to 50 gm | q.s. to 50 gm | q.s. to 50 gm |

### Evaluation of Herbal Gel [4,18]

Gel was evaluated by various following evaluation parameters.

### Physical properties

The gel was evaluated by various physical properties like visual appearance, color, state, greasiness and phase separation.

### Determination of pH

The pH value of gel was measured by digital pH meter. About 1% aqueous solution of gel was prepared and pH was measured.

### Viscosity

Brookfield Viscometer (model DV-E) was used for determination of viscosity of gel formulations. Viscosity was determined at 10 rpm, using spindle no. 64 at 25°C. Gel was taken upto the mouth in 100 ml beaker and spindle was inserted up to the mark of it. Viscosity was recorded at 10 rpm.

### Spreading Coefficient

Spreading Coefficient was calculated according to method discussed by Puri Dinesh et al. [12] by using apparatus developed in laboratory. Formula for calculation of Spreading Coefficient (S).

**S = m.l/t**

Where, S – 'spread ability coefficient', m- 'weight tied to upper glass slide',

l-'length moved on glass slide', t- 'time'.

### Skin irritation test

Skin irritation test for optimized gel was carried out in three guinea pigs. Thigh region was shaved and cleaned with surgical spirit before application of gel. The skin was observed after 24hrs, 48 hrs and 72 hrs for erythema and edema.

### Antifungal test of gel

The optimized formula of gel was tested for antifungal

activity by using cup plate method. Prepared gel was placed in the wells. The plates were incubated for 24 hrs. at 28° C. The zones of inhibitions formed in the medium were measured at the end of period. All experiments were done in three replicates [19].

**Stability study**

Stability study for optimized formula of gel was carried out according to ICH guideline. The gel was filled in suitable container and placed in humidity chamber maintained at 40 ± 2 °C / 75 ± 5 % RH for one months. The parameters like physical appearance, pH and viscosity were studied at day 0, 15th day and 30th day.

## RESULT AND DISCUSSION

**Determination of Minimum Inhibitory Concentration (MIC) and Zone of Inhibition of HA Extract**

Antimicrobial study of HA extract of *Fagonia schweinfurthii* hadidi was carried out by determining the MIC and Zone of Inhibition. Results are given in Table 2. Results shown that MIC against *Candida albicans* and *Malassezia furfur* was found to be 100 µg/ml and 90 µg/ml respectively while zone of inhibition was found to be 39 ± 1.7 mm and 42± 1.2 mm respectively. Results reveals that Ha extract more potent against Malassezia furfur.

**Table 2:** MIC and Zone of Inhibition of HA Extract

| Microbial Strains | MIC (µg/ml) | Zone of Inhibition (mm) |
|---|---|---|
| Candida albicans | 100 | 39 ± 1.7 |
| Malassezia furfur | 90 | 42± 1.2 |

**Evaluation of Herbal Gel**

Different nine formulations were prepared and tested for various physical parameters.

All the formulations were found to be off-white in color, semi-solid and there was no phase separation was found. The results of other physical parameters like pH, viscosity and spreading coefficient were observed as in following Table 3.

**Table 3: Viscosity &Spreading coefficient**

| Formulation Code | pH | Viscosity (in cp) | Spreading Coefficient (gm.cm/sec) |
|---|---|---|---|
| F 1 | 6.8 | 11653±45 | 25.45±3 |
| F 2 | 6.8 | 12631±64 | 25.55±1 |
| F 3 | 6.9 | 13232±52 | 24.65±7 |
| F 4 | 6.8 | 13876±34 | 24.05±2 |
| F 5 | 6.9 | 14453±32 | 23.89±6 |
| F 6 | 6.9 | 14987±86 | 22.54±2 |
| F 7 | 6.8 | 16465±24 | 21.34±3 |
| F 8 | 6.9 | 18122±33 | 20.68±6 |
| F 9 | 6.9 | 18567±81 | 20.31±5 |
| Marketed product | 6.8 | 14267±22 | 23.09±8 |

All properties of the formulation were compared with marketed product. The results reveal that all the values of F5 was nearer to marketed formulation, therefore F5 was selected as optimized formulation and further study was done.

**Skin irritation test**

Skin irritation test for F5 formulation was carried out in three guinea pigs. After the end of study there were no symptoms of erythema and edema was found on skin. The study indicated that prepared formulation was safe.

**Antifungal test of gel**

Herbal gels were tested for anti-fungal activity against *Candida albicans* and *Malassezia furfur* using cup-plate method. After incubation of plates for 24 hrs following observation of zone of inhibition were to be found in table no.3 and comparative data shown in figure 1. Observations were compared with marked product.

**Skin irritation test**

Skin irritation test for F5 formulation was carried out in three guinea pigs. After the end of study there were no symptoms of erythema and edema was found on skin. The study indicated that prepared formulation was safe.

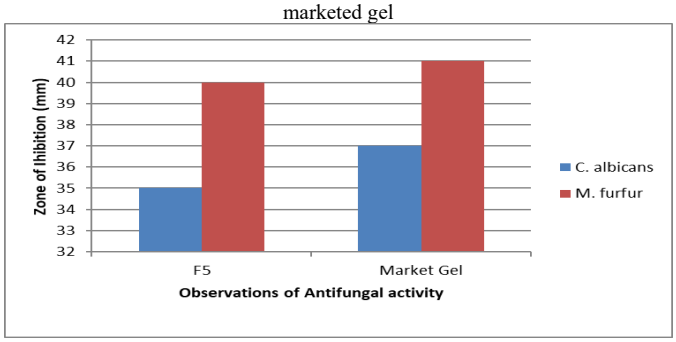
**Antifungal test of gel**

Herbal gels were tested for anti-fungal activity against *Candida albicans* and *Malassezia furfur* using cup-plate method. After incubation of plates for 24 hrs following observation of zone of inhibition were to be found in Table 4 and comparative data shown in Figure 1. Observations were compared with marked product.

**Table 4:** Diameter of Zone of Inhibition against *Candida albicans* and *Malassezia furfur*

| Microorganism | F5 Formulation | Marketed Formulation |
|---|---|---|
| *Candida albicans* | 35 ± 1.2 mm | 37 ± 1.4 mm |
| *Malassezia furfur* | 40± 1.4 mm | 41± 1.3 mm |

**Figure 1:** Bar Graph represents anti-fungal activity of F5 formulation and marketed gel




**Stability testing**

Stability of gel formulation F5 was carried out for 30 days. The following data which is given in Table 5 were observed after 15th and 30th days. The values of parameters show that there were no significant changes found during stability study. So, the prepared gel was stable and passed stability study.

**Table 5: Stability study of Herbal cream**

| Time (Days) | pH | Viscosity (in cp) | Physical Appearance |
|---|---|---|---|
| 0 | 6.9 | 14453±32 | No phase separation |
| 15th | 6.9 | 14532±15 | No phase separation |
| 30th | 6.8 | 14611±56 | No phase separation |

## CONCLUSION

Antimicrobial study of hydroalcoholic extract of *Fagonia schweinfurthii* hadidi shown that it has optimum anti-fungal activity against good in *Candida albicans* and *Malassezia furfur*. Nine formulations of herbal gel were formulated using hydroalcoholic extract of *Fagonia schweinfurthii* hadidi. In all the formulations 2gm extract of *Fagonia schweinfurthii* hadidi and 5 gm of Aloe vera was used. On the basis of various evaluation test Formulation F5was

selected as optimized. Results shows that it had no skin irritation and it was stable. Antifungal study reveals that formulation had potent antifungal activity against *Candida albicans* and Malassezia furfur

## DECLARATIONS

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