RESEARCH ARTICLE

Formulation and Evaluation of Anti-fungal Polyherbal Hair Gel

Mude S, Shete V*

Datta Meghe College of Pharmacy, Datta Meghe Institute of Higher Education and Research, (DU), Wardha, Maharashtra, India.

Received: 23rd May 2024; Revised: 20th Sep, 2024; Accepted: 6th Nov, 2024; Available Online: 25th Dec, 2024

ABSTRACT

Throughout ancient times, medicinal plants have been a primary source of treatment for human ailments. It makes sense that the 1.42 billion people who make up the world's population, or one in four, rely on traditional medicine to cure a variety of illnesses. To encourage hair development, a range of herbal herbs are utilized. The current study used neem, fenugreek seeds, tea tree oil, aloe vera, and lemon to develop and assess a polyherbal gel. The antibacterial capabilities of this gel were assessed in relation to candida albicans. The created formulation exhibits a positive zone of inhibition. Further assessment of the gel's physiochemical characteristics, including spreadability, viscosity, pH, and stability studies, was conducted.

Keywords: antifungal gel, polyherbal hair gel, fenugreek, neem.

How to cite this article: Mude S, Shete V. Formulation and Evaluation of Anti-fungal Polyherbal Hair Gel. International Journal of Drug Delivery Technology. 2024;14(4):2068-72 . doi: 10.25258/ijddt.14.4.18

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

However, now, there is a wide and expanding range of specific antifungal antimicrobials. Deeper or systemic fungal infections occur when fungi invade deeper tissues or enter the bloodstream, potentially spreading to other organs in the body. Immunocompromised individuals. Patients undergoing chemotherapy, organ transplant recipients, and individuals with HIV/AIDS are most vulnerable to these diseases.[1] Invasive candidiasis, aspergillosis, cryptococcosis, and mucormycosis are a few instances of systemic fungal infections. Depending on the infection's form and location, symptoms can vary but may include fever, chills, headache, coughing, shortness of breath, and, in extreme situations, organ failure. Fungal infections, sometimes called mycoses, can affect diverse regions of the body, from minor skin infections to serious systemic disorders. They are caused by a variety of fungus.In It is inevitable to be exposed to fungal spores because fungi are present in all parts of the environment, including the soil, water, plants, and air. Many fungi are benign, but when they enter the body through the skin, food, or inhalation, some can become pathogenic. Trichosporon species are responsible for the superficial fungal infection known as "white piedra" in hair.It may cause greater fragility and manifest clinically as white nodules encasing the hair shafts. Based on clinical and microbiologic characteristics, it can typically be easily distinguished from clinically comparable illnesses. Trichosporon species are the source of the superficial, asymptomatic fungal infection known as "white piedra." As the name suggests, white piedra's nodules are white or beige in color and comparatively milder than black piedra's, which are black and extremely rigid. While it is not a common characteristic of white piedra, hair fragility is heightened in black piedra. Depending on the extent and location of the illness, antifungal drugs may be administered orally, topically, or intravenously as a means of treating fungal infections. Specific elements of the fungal cell wall are the target of antifungal medications, which also interfere with the metabolism of the fungus to cause cell death. [2] Polyenes, azoles, echinocandins, and allylamines are examples of common antifungal substances. Several factors influence the choice of antifungal therapy, including the type of fungus causing the illness, how susceptible it is to antifungal medications, the patient's general health, and any underlying medical disorders. The management of underlying medical disorders, wound care, hydration, nutrition, and supportive measures are crucial components of treatment, in addition to antifungal medication. Understanding how fungi grow, reproduce, evade host defences, and cause disease is crucial for developing targeted interventions to disrupt their lifecycle and mitigate their impact on human health. Moreover, advances in genomic and molecular techniques have revolutionized our ability to study fungal pathogens at the genetic and molecular levels, revealing insights into their evolution, adaptation, and interactions with host cells.[3] The rising number of immunocompromised people, particularly in children, is closely linked to the rise in fungal infections. This is because medical practices have changed, resulting in the usage of immunosuppressive medications and intense chemotherapy. A fragile ecosystem of many microorganisms, including fungi, coexists on the human scalp. Dermatophytes are the most frequent fungi that cause tinea capiis, a fungal infection of the scalp. These infections usually show up as scalp postules, inflammation, hair loss, scaling, and itching.

These diseases, which include ringworm, folliculitis, and dandruff, may be difficult to manage and treat in addition t o being cosmetically bothersome..

**Author for Correspondence: vaishnavishete.pharmacy@dmiher.edu.in*

Table 1: Observation of preliminary phytochemical testing

Test	Herbal Ingredients			
	Neem	Fenugreek	Aloe vera	Lemon
Alkaloids				
Mayer's test	Positive	Positive	Positive	Negative
Dragendorff's test	Positive	Positive	Positive	Negative
Carbohydrates				
Molisch's test	Positive	Positive	Positive	Positive
Barfoed's test	Positive	Positive	Positive	Positive
Flavonoids				
Shibitas test	Positive	Positive	Positive	Positive
Pew's test	Positive	Positive	Positive	Positive
Tannins				
Ferric chloride test	Positive	Positive	Positive	Negative
Saponins				
Frothing test	Positive	Positive	Positive	Positive

Table 2: Concentration of the herbal ingredients

Ingredients	B1	B2	B3
Carbapol	1%	2%	3%
PEG	10ml	10ml	10ml
Methyl paraben	0.2ml	0.2ml	0.2ml
Propyl paraben	0.1ml	0.1ml	0.1ml
Triethanolamine	q.s.	q.s.	q.s.
Glycerine	1ml	1ml	1ml
Distilled water	Upto 100ml	Upto 100ml	Upto 100ml

Table 3: Different formulation

Ingredients	F1	F2	F3
Optimized base (B2)	95 g	90 g	85 g
Neem	1ml	2ml	3ml
Fenugreek seeds	1ml	2ml	3ml
Tea tree oil	1ml	2ml	3ml
Aloevera	1ml	2ml	3ml
Lemon	1ml	2ml	3ml

While dermatophytes are the most frequent culprits, other fungi can also cause fungal infections of the scalp.

Antifungal infections of the hair and scalp can result from imbalances in the symbiotic connection, even if it is normally harmonious. In addition to causing cosmetic difficulties, these diseases, which include ringworm, folliculitis, and dandruff, also provide management and treatment challenges. Several fungi can cause tinea capiis, or fungal infection of the scalp, although dermatophytes are the most frequent offenders. Itching, scaling, hair loss, and occasionally inflammation or postules on the scalp are the usual symptoms of these illnesses. Poor hygiene, warm, humid environments, weakened immune systems, and intimate contact with animals or people who are infected are among the factors that lead to antifungal infections in hair. Topical or oral antifungal medicines are frequently used to treat hair infections caused by fungi. Nonetheless, new problems like drug resistance and infection recurrence highlight the necessity of all-encompassing treatment plans.Known medically as tinea capitis, fungal infections of the hair are a complex dermatological disorder marked by the infiltration of dermatophyte fungus into the hair shafts and surrounding skin. A variety of clinical manifestations are indicative of this complex interaction between the virus and the host; children are primarily affected, but people of all ages can also be affected. Various symptoms include scaling, itching, erythema, and hair loss in isolated patches are part of the varied clinical picture of tinea capitis, which frequently raises concerns and calls for immediate medical intervention. Tinea capitis is usually treated with a combination of measures to get rid of the fungal infection, reduce symptoms, and stop it from coming back.10 Because of their systemic distribution and capacity to enter hair follicles, oral antifungal drugs like griseofulvin, terbinafine, or itraconazole serve as the cornerstone of therapy. Depending on the severity of the illness and the causative organism, these drugs are usually used for a period of several weeks to months.[4]

MATERIALS AND METHODS:

Material: Neem leaves, aloe vera leaves and lemon fruits were collected from the farm sites of Wardha district with the help of natives by identification through its local name. Tea tree oil and fenugreek seeds were purchased from the local Wardha market. Carbapol, polyethylene glycol, methyl paraben, and propyl paraben was supplied by the Sigma Chemicals Pvt Ltd, Mumbai.

Methodologies

Authentication of herbal ingredients: The herbal ingredients were authenticated from botanical department of Jamnalal Bajaj College of Science, Wardha (17/ Botany/2023-2024).

Extraction of herbal ingredients

Neem

With distilled water, neem leaves were cleaned. The leaves were exposed to sunshine for a duration of three days to facilitate drying. Subsequently, the leaves underwent pulverization. Two hours were spent using a Soxhlet extractor to extract 26.0 g of powdered neem leaves from 300 ml of methanol solvent. The methanol solvent was entirely evaporated after filtering it following the extraction.

Fenugreek seeds

Using a Soxhlet extractor and 600 mL of n-hexane, 100 g of crushed fenugreek seeds were extracted for three hours

Table No. 4: Physico-chemical evaluations of poly-herbal anti-fungal hair gel.

Sr. No.	Parameters	F1	F2	F3
1.	Physical appearance	Transparent gel	Transparent gel	Transparent gel
2.	Colour	Light green	Green	Dark green
3.	Odour	Characteristic	Characteristic	Characteristic
4.	Homogeneity	Homogeneous	Homogeneous	Small aggregates
5.	pH	6.7	6.8	6.1
6.	Viscosity (cp)	1536	1487	1398
7.	Spreadability (mm)	20.26	21.89	23.02

Table No. 5: Anti- Fungal Evaluation of poly-herbal anti-fungal gel

	Zone of inhibition (mm)				
Triplicate	1	2	3	Mean	Std. Dev
Control	No Zone	No Zone	No Zone	-	-
2% Formulation	7.1	7.3	7.6	7.33	0.2054

at 65–70 OC. Next, a No. 1 paper filter (Whatman) was used to filter the solvent-oil mixture. After transferring the extract into a round flask, the solvent was removed with a rotary evaporator.

Aloe vera

The aloe vera leaves were cleansed, and all of the yellow sap was drained out by standing them upright in a beaker for 15 to 20 minutes. The aloe leaf pulp was removed and ground into a fine powder in the mixer to create liquid foam. To get rid of any last bits of debris, this liquid was filtered. Subsequently, it was brought to a boil at 70℃ to create a homogenous gel and eliminate any leftover yellow sap, if any.

Lemon

Lemons were cut into two equal halves and were squeezed to take out lemon juice for further process.

Preliminary phytochemical screening of extracts:

Test for alkaloids

Mayer's reagent (Bertrand's reagent): A portion of the acidic solution was combined with a few drops of Mayer's reagent in a test tube. The mixture was then observed for the development of an opalescence or yellowish precipitate, which would suggest the presence of alkaloids.

Dragendorff's reagent: Two milliliters (2 mL) of an acidic solution were placed in the second test tube and neutralized with 10% ammonia solution. The turbidity or precipitate that was observed after applying Dragendorff's reagent indicated whether alkaloids were present.

Test for carbohydrates

Molisch's test: Two milliliters of the extract's aqueous solution were mixed with a few drops of Molischs solution, and then a tiny amount of strong sulfuric acid was let to drip down the test tube's side to create a layer without being shaken. A purple color on the interface was noticed, which is a sign that carbs are present.

Barfoed's test: Before heating the test tube in a water bath for approximately two minutes, one milliliter (1 mL) of the extract's aqueous solution and one milliliter of Barfoed's reagent were added. The presence of monosaccharaides was shown by red precipitate.

Test for flavonoids

Shibita's reaction test: A gram (1 g) of the water extract was heated to dissolve it in 50% methanol (1-2 mL), followed by the addition of 5–6 drops of strong HCl and metal magnesium. Flavones were represented by an orange solution, and flavonols by a red one.

Pew's test : Eight milliliters (mL) of concentrated sulfuric acid and 0.1 gram of metallic zinc were combined with five milliliters (5 mL) of the water extract's aqueous solution.

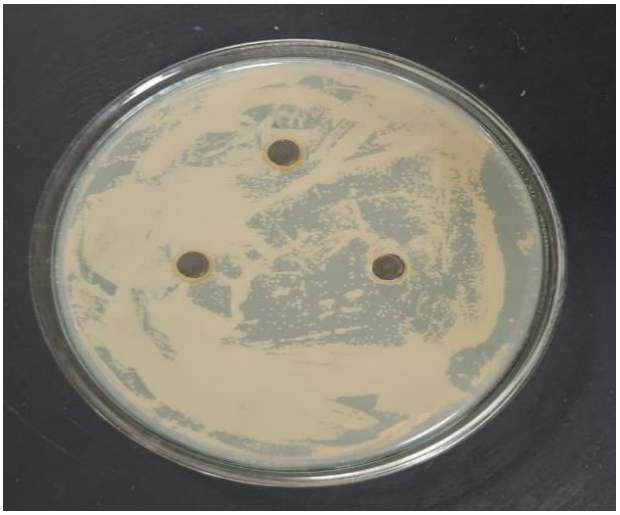

Figure 1: Control formulation

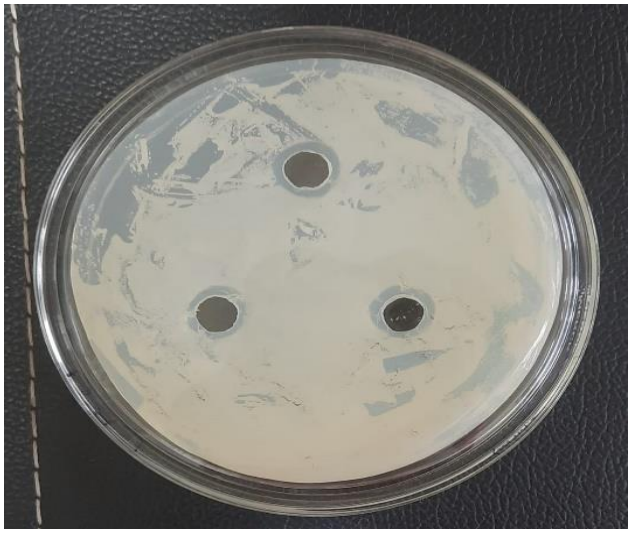

Figure 2: F2 formulation

The combination was examined for redness, which is a sign of flavonols. 5

Test for tannins

Ferric chloride test: A few drops of 10% ferric chloride solution (bright yellow) were added to the extract's aqueous solution to make two milliliters (2 mL). Colors ranging from black to blue indicated the presence of gallic tannins, while colors ranging from green to blackish indicated the presence of catechol tannins.

Test for saponins

Frothing Test: In a test tube, 10 mL of distilled water and three milliliters (3 mL) of the extract's aqueous solution were combined. After 30 minutes of standing and a 5- to 6-minute vigorous shake, the test tube was sealed and checked for the formation of honeycomb froth, which is a sign of saponins.

Optimization of gel base

Different concentrations (1, 2, and 3%) of carbapol (gelling agent) has been used for the base preparation along with the constant amount of methyl paraben and propyl paraben. Bases were named as B1, B2 & B3. On the basis of physicochemical characters, optimized gel base has been selected.

Formulation of anti-fungal poly-herbal hair gel

All herbal extracts were added into the previously optimized gel base with different concentration (1, 2, and 3%) named as F1, F2, and F3. [6]

Physico-chemical evaluation of anti-fungal poly-herbal hair gel:

Organoleptic Properties

Physical characteristics such as color, odor, and homogeneity were assessed for the gel formulation. The gel that was obtained seemed to have a faint green hue. It was discovered that the resulting gel had a distinctive smell. After setting in the container, the developed gel was visually inspected to ensure homogeneity. Its appearance, presence of aggregates, and flocculates were examined.

pH

The pH of the gel formulation was measured using a digital PH meter. After three measurements, the average pH value was ascertained by dissolving one gram of gel in one hundred milliliters of distilled water. [9]

Viscosity

Using a Brookfield rotational viscometer with spindle number 64, the viscosity of the herbal gel was measured at 100 rpm. For every sample, the viscosity was measured three times, and the average value was determined.

Spreadability

The spreading diameter of one gram of gel between two horizontal plates was measured in order to assess the spreadability of the gel formulation. All three of the samples (F1, F2, and F3) were evaluated for spreadability.

***In-vitro* antifungal test**

Using a cup plate method, the antifungal activity of the herbal gel was assessed. Candida albicans was the target of the gel's testing. For a full day of incubation, a loopful of pure fungal culture was suspended in Sabouraud dextrose agar. The zone of inhibition surrounding the bore was later measured and documented.

Stability study

The goal of stability testing is to offer proof regarding the quality of a medicinal product under various environmental influences, including light, humidity, and storage conditions. The gel formulation was kept for 20 days at room temperature between 25 and 300 c, and any alterations in its physical properties and assessment metrics were noted. [10]

RESULTS AND DISCUSSION:

Preliminary phytochemical screening of extracts

Neem leave extract, fenugreek seed extract, aloe vera leave extract, and lemon extract were preliminarily evaluated for the presence of phytochemicals, as shown in table no. 1.

Base optimization of gel:

Three different bases were prepared using different concentrations of carbapol i.e. gelling agent. B1 (1%), B2 (2%), and B3 (3%) were the three types of base as shown in table no. 2. Formulated bases were optimized on the basis of its viscosity. Formulation B2 with gelling agent concentration 2% has shown the moderate viscosity, that was denoting the optimum gel strength and hence B2 has considered as optimized gel base.

Formulation of polyherbal hair gel:

All the five herbal extracts were mixed with the previously optimised B2 gel base with different concentrations and further evaluated.

Physico-chemical evaluations of poly-herbal anti-fungal hair gel

All the three formulations were evaluated and for its organoleptic properties, pH, viscosity, and spredability as shown in table no. 3. Amongst all the formulations F2 has shown the optimum results. It was homogeneous in nature and no aggregates were found in it. pH of the same was nearest to the neutral. Also it has shown the moderate viscosity and spredability. Because of the moderate viscosity it was easy to get it release from the container as compare to the low or high viscous gel. Low viscous gel might have leak from the container and high viscous gel might have demanded for the application of high pressure for releasing from container. So as for the spredability, hence F2 was consider as the optimum formulation and further evaluated for its functional characterization.

***In-vitro* anti- fungal evaluation of polyherbal poly-herbal anti-fungal gel**

The Formulated poly-herbal hair gel was evaluated by cup plate method. The gel was tested against candida abicans. The control formulation will not posess any changes while F2 formulation will contain changes. The media used for antifungal property is sabouraud dextrose agar.

SUMMARY AND CONCLUSION

This Formulation aimed at developing herbal hair gel for anti-fungal purpose. Using different concentrations of carbapol, gel base has been formulated and further optimized on the basis of its physical characterization B2 was considered as a optimized gel base. Extraction of the neem leaves, aloe vera leaves, lemon fruit, and fenugreek seeds were conducted on the laboratory scale. Tea tree oil purchased from the local market of Wardha city. All five extracts were taken at three different concentrations and

mixed with the previously optimized gel base. All three formulations were characterized for organoleptic, physico-chemical and functional parameters. On the basis of organoleptic and physico-chemical parameters F2 formulation was considered as the optimum one, and further evaluated for the functional characterization. F2 formulation has shown the optimum anti-fungal activity as compared to the control one. From the obtained results we can conclude that the parameters defined for the standardization of polyherbal antifungal hair gel are efficient enough to consider for quality control department for ensuring the consistency of the finished product is maintained.

REFERENCES

1. Pruitt AA. Central nervous system infections in immunocompromised patients. Current neurology and neuroscience reports. 2021 Jul;21(7):37.
2. Garber G. An overview of fungal infections. Drugs. 2001 Dec;61(Suppl 1):1-12.
3. Gaurav V, Grover C, Das S, Rai G. White piedra: An uncommon superficial fungal infection of hair. Skin appendage disorders. 2022 Jan 7;8(1):34-7.
4. Hani U, Shivakumar GH, Vaghela R, Osmani AM, Shrivastava A. Candidiasis: A fungal infection-current challenges and progress in prevention and treatment. Infectious disorders-drug targets (formerly current drug targets-infectious disorders). 2015 Mar 1;15(1):42-52.
5. Hochberg ME. An ecosystem framework for understanding and treating disease. Evolution, medicine, and public health. 2018;2018(1):270-86.
6. Grice EA, Segre JA. The skin microbiome. Nature reviews. Microbiology. 2011 Apr;9(4):244-53.
7. Turkington C, Dover JS. The encyclopedia of skin and skin disorders. Infobase Publishing; 2009.
8. Baumgardner DJ. Fungal infections from human and animal contact. Journal of patient-centered research and reviews. 2017;4(2):78-89.
9. Bhattacharya R, Bose D, Gulia K, Jaiswal A. Impact of antimicrobial resistance on sustainable development goals and the integrated strategies for meeting environmental and socio-economic targets. Environmental progress and sustainable energy. 2024 Jan;43(1):e14320.
10. Mayser P, Nenoff P, Reinel D, Abeck D, Brasch J, Daeschlein G, Effendy I, Ginter-Hanselmayer G, Gräser Y, Hipler UC, Höger P. S1 guidelines: Tinea capitis. JDDG: Journal der Deutschen Dermatologischen Gesellschaft. 2020 Feb;18(2):161-79.