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Formulation and Evaluation of Herbal Antifungal Ointment containing p-Chloro m-Xylenol and Herbal extracts

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ABSTRACT

Aim of the present research study is to formulate herbal anti-fungal cream with p-chloro-m-xylenol. Herbal extracts are becoming popular alternatives to synthetic treatments because they offer multi-target effects with fewer toxic side effects. Fungal infections, or mycoses, occur when harmful microscopic fungi invade tissues like skin, hair, or internal organs, causing inflammation and damage. Although millions of fungal species exist, only about 300 make humans sick. Candidiasis is an opportunistic fungal infection primarily caused by *Candida albicans* and sometimes *Candida tropicalis*. The present research studies were formulated with a combination of three unique herbal extracts that are basil oil, terpineol oil, aloe vera gel along with p-chloro m-xylenol. PCMX (0.5 g) was dissolved in polyethylene glycol (7.5 g), while aloe vera was dissolved in water at 70°C. In a China dish, liquid paraffin, hard paraffin, soft paraffin, and beeswax were melted together at 70°C. With continuous stirring, the warm aloe vera solution was incorporated into the melted base, followed by the PCMX solution, basil oil, terpineol oil, and sodium benzoate as a preservative. The mixture was then cooled to yield the final ointment formulations (F1–F3) with varying herbal concentrations. formulation F1, F2, F3 were subjected for characterization and evaluation of physiochemical parameters like FTIR studies, color and odor, type of smear, irritancy test, spreadability test, washability test, antifungal test of formulation ointment showed white color with smooth texture and free gritty particles. FTIR studies confirmed that PCMX, basil oil, terpineol oil, aloe vera gel with excipients does not show any significant change in peak hence, it is found to be compatible. All the test parameters evaluated were in acceptable range with no skin irritation. Anti-fungal studies were performed with standard control samples as Fluconazole against the fungal strain *candida albicans* by well diffusion method. All the formulation possesses effective anti-fungal properties. F1 showed 1.6 cm zone of inhibition, formulation F2 showed 2 cm and formulation F3 showed 2.1 cm zone of inhibition compared to standard sample fluconazole that is 1 cm. comparative study showed that there was minimum difference between F2 and F3 as anti-fungal action. By considering the entire test and result of formulation, F2 was found to be optimized for formulation with effective anti-fungal activity.

Keywords: PCMX, aloe vera, terpineol oil, basil oil, *candida albicans*, anti-fungal ointment

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INTRODUCTION

Fungal infections are medically known as “Mycoses”; it occurs when fungi (which are microscopic in nature) such as yeast, molds, or when dimorphic fungi overviews human tissue and invades skin, nails, hairs, mucus membrane or internal organs. Only 300 species in fungal can make humans sick even if it's in million species count.¹

Fungal infections can be caused by the pathogenic fungi that grow on or inside the body which can lead our body to inflammation, tissue damage, and many other symptoms.²

Due to its synergistic therapeutic effect herbal extracts are gaining more attention than synthetic, it also lowers the toxicity risks and improves multi-target mechanism of action.

CANDIDIASIS

Candidiasis is an opportunistic fungal infection commonly caused by *Candida albicans* and occasionally by *Candida tropicalis*. In human beings, *Candida* species are present as normal flora of the skin and mucocutaneous areas, intestines, and vagina. The organism becomes pathogenic when the balance between the host and the organism is disturbed.

Various predisposing factors are impaired immunity, prolonged use of oral contraceptives, long-term antibiotic therapy, corticosteroid therapy, diabetes mellitus, obesity, pregnancy etc.³

MORPHOLOGIC FEATURES

Candida produces superficial infections of the skin and mucous membranes, or may invade deeper tissues as described,

Oral thrush: This is the most common form of muco-cutaneous candidiasis seen especially in early life. Full-fledged lesions consist of creamy white pseudo membrane buccal mucosa. In severe cases, ulceration may be seen

Candidal vaginitis: are composed of fungi covering the tongue, soft palate, and vaginitis. Vaginal candidiasis or monilial vaginitis is characterized clinically by thick, yellow, curdy discharge. The lesions form the pseudo membrane of fungi on the vaginal mucosa. They are quite pruritic and may extend to involve the vulva (vulvovaginitis) and the perineum.

Cutaneous candidiasis:

Candidal involvement of nail folds producing change in the shape of nail plate (paronychia) and colonization in the intertriginous areas of the skin, axilla, groin, infra - and inter-mammary, intergluteal folds and interdigital spaces are some of the common forms of cutaneous lesions caused by *Candida albicans*

Systemic candidiasis:

Invasive candidiasis is rare and is usually a terminal event of an underlying disorder associated with an impaired immune system. Organisms enter the body through an ulcerative lesion on the skin and mucosa or may be introduced by iatrogenic means such as via intravenous infusion, peritoneal dialysis or urinary catheterization. The lesions of systemic candidiasis are most encountered in kidneys ascending pyelonephritis and in heart as candidal endocarditis.

Normally antifungal agents play an important role by neutralizing fungi (fungicidal) or by inhibiting the growth of fungistatic. And antifungal agents help in treatment and protection of superficial infections caused by ringworms, thrush and dangerous systemic diseases such as candidemia, fungal meningitis, prophylaxis, etc.

Antifungal agents prevent the growth of fungal infection in immuno-compromised patients like HIV, AIDS, Cancer, and Transplant patients.

Common over the counter option includes Cotrimoxazole, Terbinafine, and Ketoconazole. These can be used effectively for yeast issues and mild ringworm infections.⁴

Mechanisms of Action of Antifungals agents⁶

Polyenes: It binds to ergosterol present in the fungal cell membrane which creates cell pores and causes cell leakage and death.

Azoles: The enzyme lanosterol 14- α -demethylase by blocking ergosterol synthesis.

Echinocandins: Inhibit β -D-glucan synthesis, disrupting the fungal cell wall.

Allylamines: Inhibit squalene epoxidase, blocking early ergosterol production.

Antimetabolites and Miscellaneous Agents: Flucytosine (5-FC): Converts to fluorouracil inside the cell to disrupt fungal RNA and DNA synthesis.⁷

Herbal antifungal drugs like Garlic, Turmeric, Curcuma, Aloe vera, Ginger, Apple cider vinegar, Neem leaves, Oregano oil, Coconut oil, Tea tree oil, Yogurt can be used to make herbal antifungal ointment more effective.

In this herbal antifungal ointment formulation, we are using Terpeneol oil, Basil oil, and Aloe vera gel as herbal extracts with PCMX as synthetic chemical compound and other excipients like Polyethylene glycol, hard paraffin, Soft paraffin, Liquid paraffin, Bee's wax, Sodium benzoate etc.

Phase	Ingredient	Function
Active	PCMX	Broad-spectrum antimicrobial
Active/Fragrance	Basil Oil	Natural antifungal & antibacterial
Active	Terpeneol Oil	Antifungal & Penetration enhancers
Soothing base	Aloe vera gel	Base, Skin soother, Hydration

(Ocimum basilicum L) is an essential oil obtained from basil plant crops cultivated commercially. It is widely known for its flavoring agent in food and also, it benefits in perfumes and medical

industries. It contains various phytochemicals like glycosides, proteins, and flavonoids. It is an essential oil of a plant containing volatile aromatic chemicals, it is commonly used as aromatherapy for reducing mental fatigue by inhaling and clear minor respiratory congestion also used as topical application diluted with carrier oil to soothe sore muscles and skin irritation and used for flavor enhancement for dressings. Basil oil exhibits potent, broad-spectrum antifungal activity by its high concentration of volatile bioactive compounds like linalool and methyl chavicol. It works by disrupting fungal cell membranes, causing leakage of critical cellular components, and inhibiting dangerous fungal toxins.⁷

Terpineol oil is a naturally occurring monoterpene alcohol extracted from essential oil like pine, eucalyptus, and cajuput, or synthesized from turpentine oil. It is highly valued for its pleasant, lilac-like floral fragrance and robust industrial properties. Terpineol oil has a varied range of biological activities including antifungal, antioxidant, anti-inflammatory, antimicrobial, anticancer, and analgesic effects. It is highly recognized for its potent, broad spectrum antifungal activity against human perfect food-spoiling molds. Terpineol destroys fungal cells through several distinct biological mechanisms like cell membrane disruption, structural distortion, metabolic downregulation and inhibition of dimorphic transition.⁸

PCMX (Para-chloro-meta-xyleneol): PCMX is widely known as chloroxylenol, a broad spectrum, halogen transition. (Antimicrobial compound that exhibits antifungal, antibacterial, and antiviral activities. Its structural ability to deactivate mold, yeast, and it is valuable across medical, cosmetic, and industrial fields. PCMX acts as a cellular poison to fungi. Chloroxylenol is effective against gram-positive bacteria but less active against gram-negative bacteria. Chloroxylenol is a common constituent of many disinfectants used for skin and wound disinfection. Chloroxylenol is commonly used in low concentrations as an antimicrobial & preservative in topical formulation like creams, ointments and in cosmetic formulation.⁹

Aloe vera is a succulent plant species from the genus Aloe; it is widely cultivated for its medicinal, cosmetic, and skin care applications. Aloe vera bioactive compounds found in both gel and latex anatomy, which exhibit various biological activities for skincare act as soothing sunburns, minor cuts, eczema, and providing lightweight moisture and for haircare it acts as conditioning the scalp, reducing dandruff, and strengthening hair follicles. Its inner clear gel consists of ~99% of water along with amino acids, lipids, vitamins (A, C, E, B12), enzymes, and polysaccharides. Hence, it is used in Dermatology, Cosmetics, Healthcare, Horticulture etc¹⁰

Aim

The primary aim of this study is to prepare herbal antifungal ointment using herbal extracts like Basil oil, Terpineol oil, Aloe vera gel, and to compare its efficacy with the standard antifungal activity against *Candida albicans*.

Objectives

This combination was selected because it was found to be deficient in research studies, where this combination was found to be rare and effective against synthetic conventional antifungal ointments. Our objective is to make this rare combination of herbal plant extracted into a suitable ointment formulation with more economical than synthetic drug so that it would be more beneficial for mankind.

MATERIALS AND METHOD

SI No	Ingredients	Formula For 100 G	F1	F2	F3
01	Basil oil	2g	0.5g	1g (1.05 ml)	1.5g
02	Terpineol oil	2g	0.5g	1g (1.08 ml)	1.5g
03	PCMX	1g	0.25g	0.5g	1g
04	Aloe vera	10g	5g	5g	5g
05	Polyethylene glycol	15g	7.5g	7.5g (6.64 ml)	7.5g
06	Hard paraffin	5g	3.5g	2.5g	3g
07	Soft paraffin	5g	3.5g	2.5g	3g
08	Bees wax	12g	6g	6g	5g
09	Liquid paraffin	14g	7.5g	7.5g (8.52 ml)	7.5g
10	Water	Up to 10 ml	----	----	-----

PCMX was obtained from Swadesh India Chemical Pvt Ltd, Gujarat. Basil oil was procured from Blossom Kochhar Beauty Product Pvt Ltd, Haryana. Terpineol oil was purchased from Sanket enterprises, Mumbai and aloe vera gel was purchased from local market, Bangalore. All the APIs were tested for their authentication. Ethno botanical and pharmacological importance were studied. The API was authenticated in the laboratory K2VR for analytical research, Bangalore.

Method of Preparation

First, 0.5 g of PCMX was dissolved in 7.5g of polyethylene glycol in a beaker, then aloe vera was dissolved using water in another beaker by heating on a water bath upto 70oC. and then required quantity of liquid paraffin, hard paraffin, soft paraffin, & bees wax was heated in china dish by heating on up to 70. Then aloe vera solution was added into the china dish slowly by constant stirring, later PCMX solution was added slowly to this solution, with constant stirring. The required amount of basil oil and terpineol oil to the solution was added to the above mixture. The preservative sodium benzoate was added at the end. When the temperature cooled, ointment formed.

Evaluation

Color and odor

Physical parameters like color and odor were examined by visual examination.

Homogeneity: The formulation was tested for homogeneity by visual appearance and by touch with the fingers.

FTIR studies

FTIR studies for herbal antifungal ointment samples were performed and determined the antifungal activity from all samples against the fungi “*Candida albicans*”.

pH test

The pH meter was calibrated using a standard buffer solution. About 0.5 grams of the ointment were weighed and dissolved in 50.0 ml of distilled water, and its pH was measured.

Type of smear

After the application of ointment, the type of film or smear formed on the skin was checked.

Irritancy test

Mark an area (1 sq.cm) on the left-hand dorsal surfaces; the ointment was applied to the surface to the specified area and time was noted. Irritancy, erythema, edema, was checked for regular intervals up to 12 hrs. and reported.

Spreadability test:

Spreadability was expressed in terms of time in seconds taken by two sides to slip off from the ointment, placed in between the slides, under a certain load. The less time taken for separation of the two slides the better the spreadability. Two sets of glass slides of standard dimension were taken. Then one side of suitable dimensions was taken, and the ointment formulation was added. Then a weight or certain load was placed on the upper side so that the ointment between the two slides was pressed uniformly to form a thin layer. Then the weight was removed and excess of formulation adhering to the slides was scrapped off. The upper side was allowed to slip off freely by the force of weight tied to it. The time taken by the upper slide to slip off was noted.

Washability test

In wash ability a small amount of ointment was applied on the hand, and it is washed with tap water.

Stability studies of formulation F2 and F3

Stability studies for formulation F2 and F3 were done at varying temperatures and after 1 month the above tests were repeated.

Anti-fungal Studies

The anti-fungal activity of ointment was evaluated and carried out by the Agar well diffusion method. The strains used were candida albicans, the test fungal strain was inoculated into the suitable fungal growth medium, and the wells were prepared in the agar plate. The different concentrations of the formulated ointment were introduced into the wells, The plates were incubated under appropriate conditions, after that the zone of inhibition around each well was measured in millimeters. The antifungal activity of the formulation was assessed by comparing the zone of inhibition produced by the test formulation with that of the standard drug (Fluconazole). A larger zone of inhibition indicated greater antifungal availability.

RESULTS

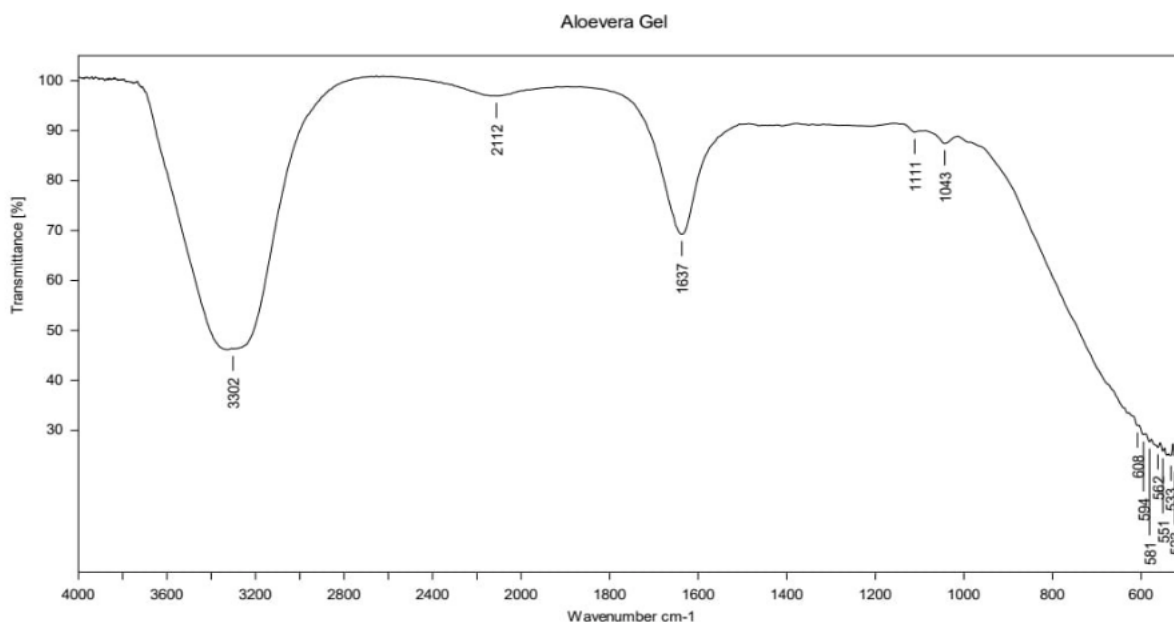
Color and odor

All three formulations were assessed for their color and odor physically. All the three formulations (F1,F2, F3) showed snow white color, with an elegant appearance and smooth texture. None of the formulations showed any gritty particles or abrasive nature. The odor was pleasant, containing a strong basil fragrance.

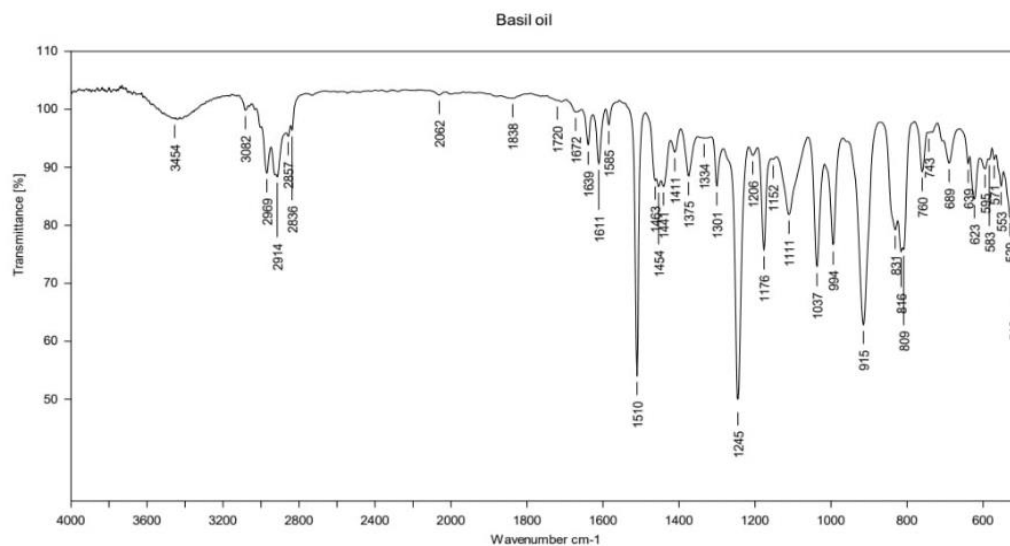
Formulation	Color	odor
F1	white with elegant appearance	Strong Basil fragrance
F2	white with elegant appearance	Strong Basil fragrance
F3	white with elegant appearance	Strong Basil fragrance

FTIR STUDIES

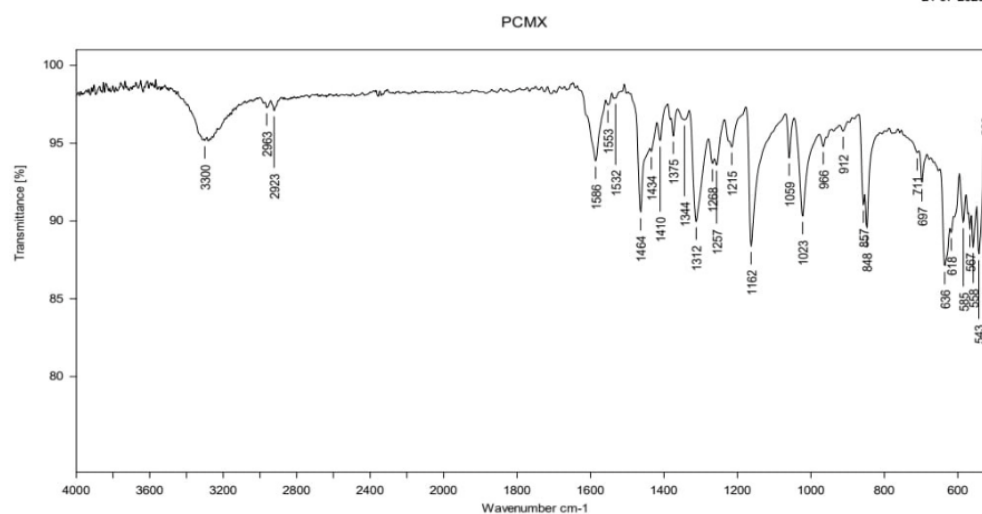
Aloe Vera Gel



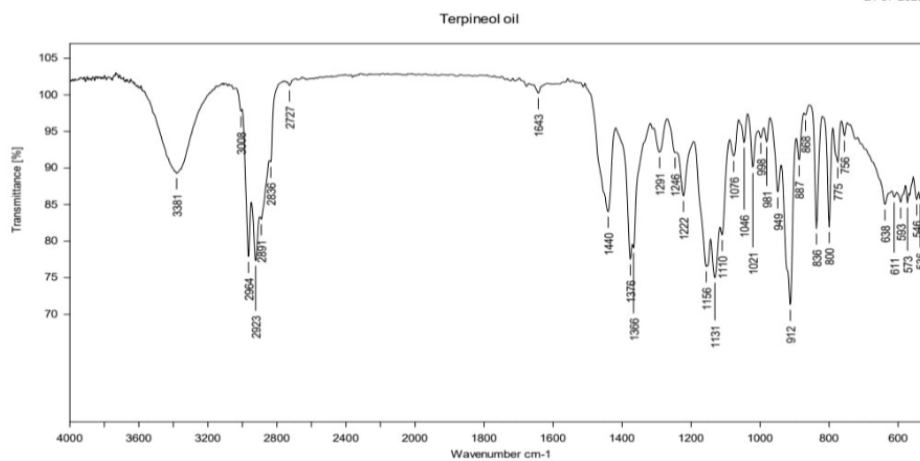
Basil Oil



PCMX

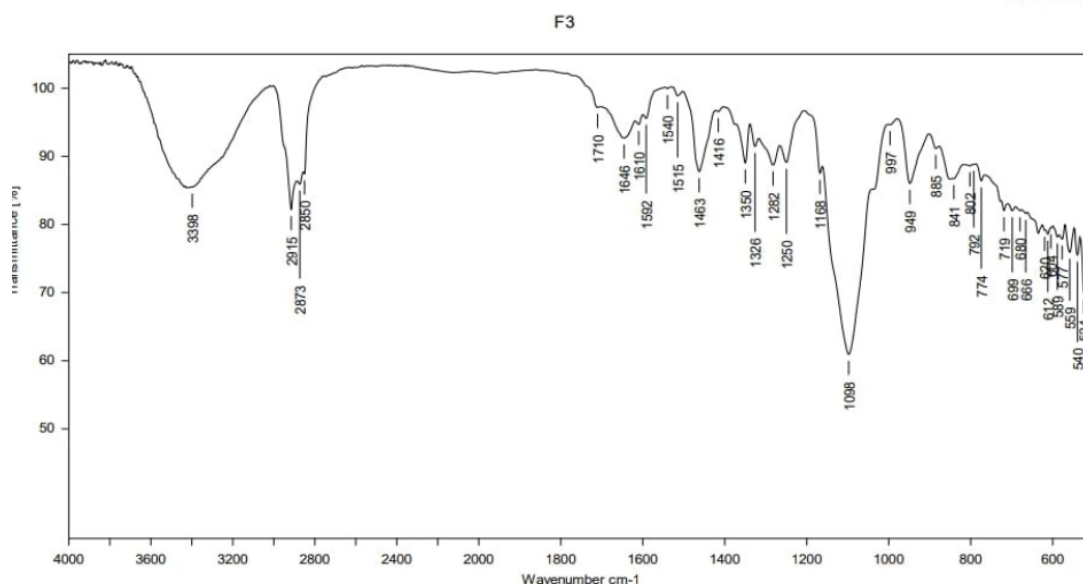


Terpineol Oil



E. ALOE VERA + BASIL OIL + PCMX + TERPIENOL OIL

Formulation F3



FTIR study interpretation:

Aloe vera gel

The FTIR spectrum of Aloe vera showed a broad absorption band at approximately 3302 cm^{-1} , corresponding to O–H stretching. The band around 1637 cm^{-1} can be attributed to C=O/C=C-related vibrations, while bands near 1111 and 1034 cm^{-1} are associated mainly with C–O stretching vibrations. These peaks indicate the presence of hydroxyl and other oxygen-containing functional groups in Aloe vera.

Basil Oil

Basil oil exhibited characteristic bands around $\sim 3082 \text{ cm}^{-1}$, 2969–2860 cm^{-1} , 1672–1611 cm^{-1} , and 1454–1375 cm^{-1} , corresponding mainly to C–H stretching, C=C stretching and C–H bending vibrations. Several peaks in the 1200–900 cm^{-1} region are associated with C–O and fingerprint-region vibrations of its constituents.

PCMX

The PCMX spectrum showed a broad band around 3300 cm^{-1} , bands around 2963–2923 cm^{-1} due to C–H stretching, and characteristic fingerprint-region peaks between approximately 1500 and 600 cm^{-1} . These peaks are consistent with the functional groups present in PCMX.

Terpineol oil

Terpineol showed a broad O–H band at approximately 3381 cm^{-1} , C–H stretching bands around 3008–2864 cm^{-1} , and a band near 1643 cm^{-1} associated with C=C stretching. Multiple fingerprint-region peaks between 1500 and 600 cm^{-1} correspond to C–H bending and other skeletal vibrations.

PCMX + Basil oil + Terpineol oil + Aloe vera

The combined sample showed characteristic absorption bands from the individual ingredients, including bands around 3379, 3008, 2965, 2924, 2863, 1640–1611, 1465, 1378, 1223, 1168, 1110, 1079 and 1029 cm^{-1} . The presence of these characteristic bands indicates the incorporation of the major components into the combined system.

Formulation F3

The FTIR spectrum of F3 showed characteristic bands corresponding to the major ingredients used in the formulation. The important absorption bands were observed in the O–H/C–H stretching region and fingerprint region, with several peaks also appearing in the 1000–1500 cm^{-1} range. The major characteristic peaks of the individual components were retained in the formulation without the appearance of an obvious new major peak.

pH test

The pH of each formulation was tested, and it was found to be an acceptable range.

Formulation	pH	Interpretation
F1	5.2	Suitable
F2	5.5	Suitable
F3	5.8	Suitable

Smear Test

A small amount of ointment was spread as a thin film on a glass slide or suitable surface and examined for all the formulation. It was found to be smooth, less sticky, without any gritty particles.

Formulation	Smear Test
F1	Smooth texture without any gritty particle
F2	Smooth texture without any gritty particle
F3	Smooth texture without any gritty particle

Irritancy Test

A small mark (1 cm^2) on the left-hand dorsal surface was made, and ointment was applied to the surface to the marked area for 12 hours and observed for irritancy, erythema, or edema. As such, none of the formulation showed any irritancy.

Formulation	irritancy
F1	Not observed
F2	Not observed
F3	Not observed

Spreadability test

Spreadability test performed for formulation F1-F3. It was calculated by using the formula.

$$S = \frac{MXL}{T}$$

Where M= weight of the upper slide

L= length of the slide

T= time of spread

Formulation	Spreadability (g.cm/sec)	Interpretation
F1	8.2	Good
F2	9.1	Very good
F3	8.7	Good

washability

All the formulations were applied on the surface of the left-hand dorsal and tested for washability. It was found to be easily removable after 2 or 3 times wash with the water. No stains had left after a wash, and there was no sensation of stickiness after a wash with water.

Formulation	Washability
F1	Easily washable with no stains
F2	Easily washable with no stains
F3	Easily washable with no stains

Anti-fungal test

The formulations (F1, F2, F3) were subjected to anti-fungal studies by a well diffusion method. It was tested for the strains of *Candida albicans* against standard control samples (Fluconazole). The test samples were compared with the standard sample for its minimal inhibitory concentration and zone of inhibition.

Formulation F1

Test Organisms	Test compounds	Conc. Per well	Zone of inhibition (cm)
<i>Candida albicans</i>	Std (Fluconazole)	50 mcg	1.0
<i>Candida albicans</i>	Formulation (F1)	50 µg	1.6

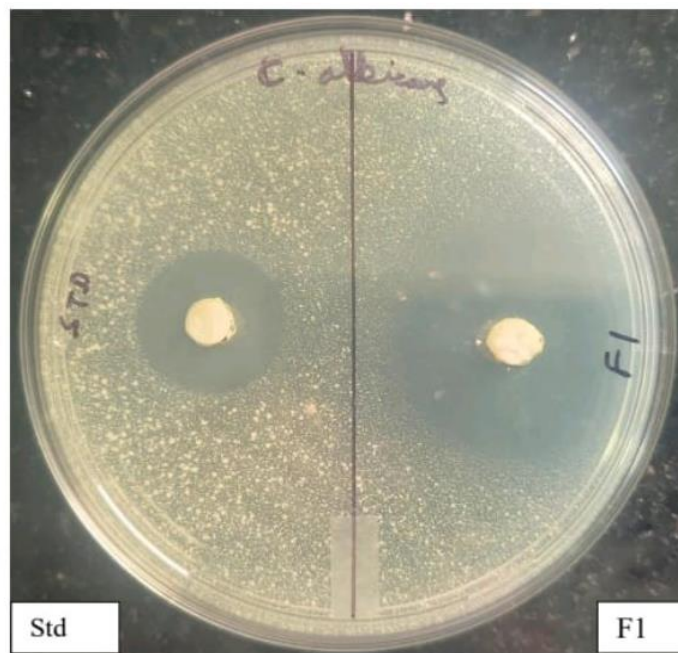


Figure : Inhibitory activity of test sample against *Candia albican*.

Formulation F2

Test Organisms	Test compounds	Conc. Per well	Zone of inhibition (cm)
Candida albicans	Std (Fluconazole)	50 mcg	1.0
Candida albicans	Formulation (F2)	50 µg	2.0

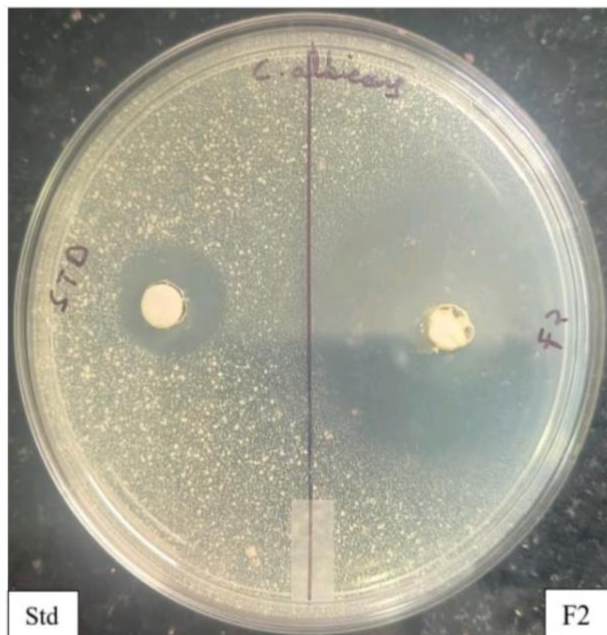


Figure : Inhibitory activity of test sample against *Candia albicans*

Formulation F3

Test Organisms	Test compounds	Conc. Per well	Zone of inhibition (cm)
Candida albicans	Std (Fluconazole)	50 mcg	1.0
Candida albicans	Formulation (F3)	50 µg	2.1

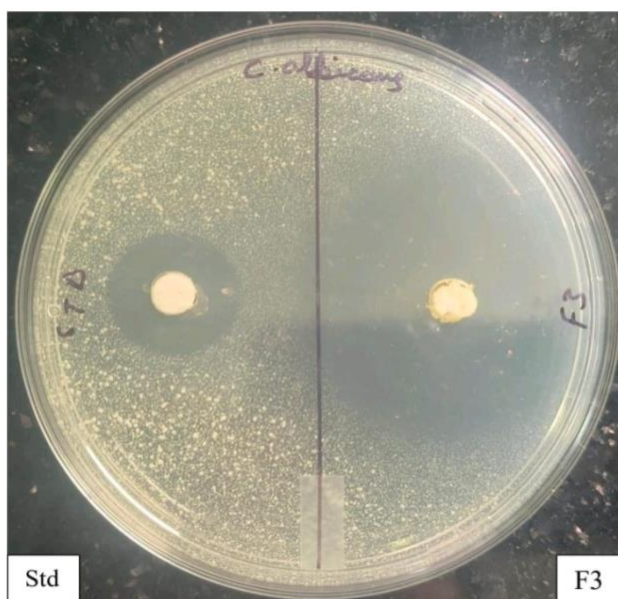


Figure : Inhibitory activity of test sample against *Candia albicans*

DISCUSSION

The appearance of all formulation showed the acceptable and elegant color of the ointment was noticed with a strong basil oil fragrance.

The FTIR spectra of PCMX, basil oil, terpineol oil, aloe vera gel and their formulations (F1–F3) were compared to evaluate possible drug–excipient interactions. The major characteristic absorption bands of the individual components were retained in the formulations, with only minor changes in peak position and intensity. No significant disappearance of characteristic peaks or appearance of prominent new absorption bands was observed. Therefore, the FTIR results indicate the absence of significant chemical interaction between PCMX and the selected excipients, suggesting that the formulation components are compatible.

The pH of the formulated antifungal ointment was found to be in the range of 5.0–6.0. The observed pH was close to the physiological pH of the skin, indicating that the formulation is suitable for topical application and is unlikely to cause pH-related skin irritation.

A smear test was performed of formulation F1_F3; it was found to be smooth, less sticky, without any gritty particles. Formulation F3 was found to have more fineness compared to F1 and F2.

Irritancy tests were performed for all formulation and there was no irritation on skin observed.

The spreadability studies indicated that the formulated ointments possessed satisfactory spreading characteristics. The formulations could be easily spread over the skin with minimal shear, indicating suitable consistency for topical application. Differences in spreadability among the formulations may be attributed to variations in the concentration of the formulation components and their effect on viscosity.

Formulation F1, F2, and F3 were tested for washability. The washability of the formulated ointments was evaluated by applying a small quantity of the formulation onto the skin and washing with water. The formulations were easily removed with water without excessive rubbing, indicating good washability. The results suggest that the prepared ointments possess satisfactory washability and are suitable for topical fungal application.

All the formulations F1, F2, and F3 showed significant anti-fungal activity compared to standard samples of fluconazole. F1 with a minimum concentration of 50 micrograms showed an effective zone of inhibition that is 1.6 cm compared to a standard sample. Whereas formulation F2 showed a 2 cm zone of inhibition and F3 showed a 2.1cm zone of inhibition. It demonstrates that formulation possesses antifungal activity.

The antifungal activity of formulations F1, F2, and F3 was evaluated against *Candida albicans* by the well diffusion method. All the formulations exhibited visible zones of inhibition, indicating

antifungal activity against the test organism. The observed activity may be attributed to the combined antimicrobial effects of PCMX, basil oil and terpineol oil, with aloe vera serving as a supportive herbal component of the formulation. Overall, the results indicate that the developed formulations possess promising antifungal activity against *C. albicans*. There was a minimum difference between F2 and F3 results, indicating that F2 formulation could be effective for antifungal diseases.

CONCLUSION:

PCMX with herbal anti-fungal ointment containing basil oil, terpineol oil and aloe vera gel was formulated successfully. It showed white color with smooth texture and free gritty particles. FTIR studies confirmed that PCMX, basil oil, terpineol oil, aloe vera gel with excipients does not show any significant change in peak hence, it is found to be compatible. The pH test showed the pH ranging from 5-6 which is suitable for topical anti-fungal ointment. Formulation F2 showed effective skin pH that is 5.8. Skin irritation was not observed in any formulations. All the formulations showed acceptable spreadable property which indicates that it was suitable for topical application. F2 showed the highest spreadability property of 9.2 compared to F1 and F2. All the formulation showed good washability characteristics which indicates that it does not contain more stickiness and more ease for the patient with topic skin infections. Anti-fungal studies were performed with standard control samples as Fluconazole against the fungal strain *candida albicans* by well diffusion method. All the formulations possess effective anti-fungal properties. F1 showed 1.6 cm zone of inhibition, formulation F2 showed 2 cm and formulation F3 showed 2.1 cm zone of inhibition compared to standard sample fluconazole that is 1 cm. A comparative study showed that there was a minimum difference between F2 and F3 as anti-fungal action. By considering the entire test and result of formulation, F2 was found to be an optimized formulation with effective anti-fungal activity.

REFERENCES

1. Preeti P, Patrick M Z. Antifungal agent. Statpearls. 2025;6(7).
2. Cassia MDS, Barbara TB, Daniel A M, Haroldo CDO. The evolution of antifungal therapy: Traditional agents, current challenges, and future perspectives. Current Research in Microbial Sciences. 2025; vol.8: 100341.
3. Khan Z, Ahamd S. *Candida albicans*-The Virulence factors and clinical Manifestations of infection. Journal of fungi.2021;7 (2):79

4. Adler-Moore JP, Proffitt RT. Development, Characterization, Efficacy and Mode of Action of Ambisome, A Unilamellar Liposomal Formulation of Amphotericin B. *J Liposome Res.* 1993;3:429-450.
5. Shirsat SP, Tambe KP, Dhakad GG, Patil PA, Jain RS. Review of Antifungal Agents. *Res J Pharmacol Pharmacodyn.* 2021;13(4):147-154.
6. Ghannoum MA, Rice LB. Antifungal Agents: Mode of Action, Mechanisms of Resistance, and Correlation of These Mechanisms with Bacterial Resistance. *Clin Microbiol Rev.* 1999;12(4):501-517. doi:10.1128/CMR.12.4.501.
7. Soomro MT, Kumar M. Development, Evaluation and Efficacy of an Ointment Formulated from Sweet Basil (*Ocimum basilicum*) for Common Dermatological Conditions.
8. Khaleel C, Tabanca N, Buchbauer G. α -Terpineol, a natural monoterpene: a review of its biological properties. *Open Chem.* 2018;16(1):349-61. doi:10.1515/chem-2018-0040.
9. Schafer E, Bossmann K. Antimicrobial efficacy of chloroxylonol and chlorhexidine in the treatment of infected root canals. *Am J Dent* 2001; 14(4): 233-237.
10. Shilpa M, Bhat V, Shetty AV, Reddy MSR, Punde P. Antifungal activity of Aloe vera leaf and gel extracts against *Candida albicans*: an in vitro study. *World J Dent.* 2020;11(1):36-40. doi:10.5005/jp-journals-10015-1701.
11. Chalak AA, Pawar SR, Surwase KP. Formulation and evaluation of herbal ointment for skin. *Int J Adv Res Sci Commun Technol.* 2025;5(1)
12. Soomro MT, Kumar M. Development, evaluation and efficacy of an ointment formulated from sweet basil (*Ocimum basilicum*) for common dermatological conditions. *J Biomed Eng Res.* 2024 (9)
13. Sawalha H, Yousef H, Shalabi R, Hamamreh R, Kmail A, Qoraan I. Phytochemical analysis and antifungal activity of Aloe vera extract against *Candida albicans*. *Scientifica (Cairo).* 2025; 2025:4496097. doi:10.1155/sci5/44960
14. Shilpa M, Bhat V, Shetty AV, Reddy MSR, Punde P. Antifungal activity of Aloe vera leaf and gel extracts against *Candida albicans*: an in vitro study. *World J Dent.* 2020;11(1):36-40. doi:10.5005/jp-journals-10015-1701
15. Li L, Shi C, Yin Z, Jia R, Peng L, Kang S, et al. Antibacterial activity of α -terpineol may induce morphostructural alterations in *Escherichia coli*. *Braz J Microbiol.* 2014;45(4):1409-1413. doi:10.1590/S1517-83822014000400035

16. Parulekar TP, Gangan VD, Mewada K, Kulkarni M, Raddi K. Synthesis and antibacterial activity of PCMX derivative. *Int J Res Appl. Sci Eng Technol.* 2024;12(1):585-589. DOI:10.22214/ijraset.2024.57998.
17. Pinto E, Gonçalves MJ, Oliveira P, Coelho J, Cavaleiro C, Salgueiro L. Activity of *Thymus caespitosus* essential oil and α -terpineol against yeasts and filamentous fungi. *J Med Microbiol.* 2006;55(10):1367-1373.
18. Saggiorato AG, Gaio I, Treichel H, Oliveira D, Cichoski AJ, Cansian RL. Antifungal activity of basil essential oil (*Ocimum basilicum* L.): evaluation in vitro and on an Italian-type sausage surface. *Food Bioprocess Technol.* 2012;5(1):378-384. doi:10.1007/s11947-009-0310-z.
19. Zagoto M, Cardia GFE, Rocha EMT, Mourão KSM, Janeiro V, Cuman RKN, Pinto AA, Contiero RL, Freitas PSL. [Article title]. 2021 Sep 24.
20. Lilhare B, Bisen K, Pahapale A, Bisen T, Lilhare R. Formulation and evaluation of herbal antifungal ointment. *Int J Pharm Sci.* 2025;3(6):5877-5885. doi:10.5281/zenodo.15773130.
21. Shireen F, Manipal S, Prabu D. Anti-fungal activity of Aloe vera: in vitro study
22. Adigüzel A, Güllüce M, Şengül M, Öğütçü H, Şahin F, Karaman İ. Antimicrobial effects of *Ocimum basilicum* (Labiatae) extract.
23. Bajpai VK, Yoon JI, Kang SC. Antifungal potential of essential oil and various organic extracts of *Nandina domestica* Thunb. against skin infectious fungal pathogens.
24. Patil S, Narvekar V, Patil V, Mali R, Patil A. A green approach to antifungal therapy: formulation and evaluation of *Clitoria ternatea*-based cream. *Asian J Res Med Pharm Sci.* 2025;14(3):275-289
25. Doddanna SJ, Patel S, Sundarrao MA, Veerabhadrappe RS. Antimicrobial activity of plant extracts on *Candida albicans*: an in vitro study. *Indian J Dent Res.* 2013;24(4):401-405.

