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## Review Paper

# Formulation Of Herbal Antifungal Cream Using Neem Extract

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### ABSTRACT

The formulation of a herbal antifungal cream using neem extract represents a scientifically relevant approach in topical drug delivery because neem (*Azadirachta indica*) is widely recognized for its medicinal value and contains diverse bioactive phytochemicals with antimicrobial and antifungal potential. Reviews of neem pharmacology describe the plant as rich in limonoids, tetranortriterpenoids, flavonoids, steroids, and related secondary metabolites, while major named constituents such as azadirachtin, nimbin, nimbolide, quercetin, and beta-sitosterol have been linked to important therapeutic activities relevant to skin care and infection control. Experimental evidence further shows that neem leaf extracts can inhibit pathogenic fungi including *Candida albicans*, *Microsporum gypseum*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus niger*, and *Aspergillus terreus*, confirming that neem is not only a traditional remedy but also a rational herbal candidate for antifungal topical formulation. A cream dosage form is especially suitable for antifungal therapy because it can remain in close contact with the infected area, spread uniformly over the skin, and improve patient compliance by offering a non-greasy, soothing, and easy-to-apply semisolid system when properly prepared. The present report addresses the preparation of a neem extract based herbal antifungal cream and presents detailed academic content under the chapters of introduction, aim and objectives, literature review, drug profile, materials and methodology, formulation development, evaluation parameters, result and discussion, conclusion, future scope, and references. The available scientific literature suggests that the therapeutic performance of neem depends not only on the selected plant part but also on the extraction solvent, concentration, and dosage-form design, which makes formulation science an essential part of developing an effective herbal cream.

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## INTRODUCTION

Fungal infections of the skin continue to represent a major concern in dermatological practice because they are extremely common, recurrent in many patients, and often associated with discomfort, cosmetic embarrassment, and reduced quality of life. Superficial fungal infections primarily affect keratinized tissues such as the stratum corneum of the skin, hair, and nails, because dermatophytes and related pathogenic fungi depend on keratin for survival and colonization. The main organisms responsible for these infections belong to the genera *Trichophyton*, *Microsporum*, and *Epidermophyton*, while yeasts such as *Candida albicans* and other opportunistic fungi may also produce clinically significant skin and mucosal disease under favorable conditions. These infections are not usually life-threatening in otherwise healthy individuals, but they can persist for long durations, recur after incomplete treatment, spread to family members through contact, and become more troublesome in humid climates, crowded living conditions, and settings with inadequate hygiene control.

### 1.1 Overview of Fungal Skin Infections

The burden of superficial fungal disease becomes even more important when examined from the perspective of daily life. Conditions such as ringworm, athlete's foot, intertrigo, and candidal skin irritation may cause itching, burning sensation, scaling, redness, cracking, inflammation, and persistent irritation that interfere with personal comfort and social confidence. Because affected areas often include visible or friction-prone body sites, many patients seek remedies that provide not only antifungal action but also soothing, anti-inflammatory, and skin-friendly effects. This demand has led researchers and formulators to consider medicinal plants that possess a broader therapeutic profile

than a narrow fungicidal effect alone. In that context, neem has emerged as one of the most interesting medicinal plants for topical pharmaceutical development because it combines traditional acceptance with a growing body of scientific evidence relevant to skin disease management.

### 1.2 Impact of Fungal Infections on Human Health

The increasing attention toward herbal medicine is not accidental. Across many healthcare systems, there is renewed interest in plant-based therapies because medicinal plants often serve as culturally familiar, locally available, and comparatively economical sources of therapeutic agents. In addition, the study of herbal products has expanded beyond folklore into modern phytochemical and pharmacological analysis, allowing researchers to identify active constituents, explain mechanisms, and design dosage forms that make traditional remedies more standardized and acceptable in scientific practice. Herbal formulations are especially valuable in topical application because the skin permits localized treatment, lowers the need for systemic exposure, and provides an opportunity to combine therapeutic activity with emollient and protective benefits from the vehicle itself. As a result, the formulation of herbal creams, ointments, gels, and lotions has become a productive area of pharmaceutical research.

### 1.3 Importance of Herbal Medicine in Dermatology

Among the many medicinal plants studied for skin-related applications, *Azadirachta indica* A. Juss., commonly called neem, occupies a unique position. Neem is widely distributed in India and other tropical and subtropical regions and has been used for centuries in Ayurveda, folk medicine, and household remedies for treatment of skin



disorders, fever, inflammation, wounds, parasitic conditions, and microbial infections. A dermatology-focused review describes neem as a traditional panacea with possible applications in infections, inflammation, wounds, pigmentation disorders, and arthropod-related dermatoses, highlighting the breadth of its relevance to skin care. Another review devoted to the dermatological applications of neem states that the plant possesses antimicrobial, anti-inflammatory, antioxidant, antiseptic, antiviral, analgesic, and immunomodulatory activities, supporting its development as a versatile agent for multimodal skin disorders. Such evidence makes neem much more than a traditional household remedy; it positions the plant as a scientifically interesting source for topical therapeutic development.

#### 1.4 Introduction to Neem (*Azadirachta indica*)

The medicinal value of neem is closely connected to its rich phytochemical composition. Published reviews describe the plant as a reservoir of limonoids, tetranortriterpenoids, flavonoids, polyphenols, alkaloids, steroids, tannins, saponins, and other bioactive secondary metabolites. Specific constituents frequently associated with neem include azadirachtin, nimbin, nimbolide, salannin, gedunin, quercetin, and beta-sitosterol. The pharmacological importance of these compounds lies in the fact that they do not contribute to a single biological action only; rather, they collectively support antimicrobial, antifungal, antioxidant, anti-inflammatory, and protective effects that are highly desirable in topical skin therapy. Because fungal skin disorders commonly involve irritation and inflammation in addition to microbial growth, a plant with multiple supportive activities may offer advantages during formulation compared with agents chosen solely for antifungal potency.

Neem leaves are particularly important for formulation research because they are relatively

easy to collect, process, and extract, and because much of the antifungal evidence has been generated from leaf extracts. In one major study, aqueous, ethanolic, and ethyl acetate extracts of neem leaves were tested against *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *A. terreus*, *Candida albicans*, and *Microsporum gypseum*, and all three extracts showed concentration-dependent inhibitory activity. The same study reported that the 20% ethyl acetate extract demonstrated the strongest antifungal effect among the tested extracts, indicating that extraction solvent plays a decisive role in isolating active antifungal principles from neem leaves. This observation is of great significance in pharmaceutical formulation because it shows that the biological performance of a herbal product cannot be separated from extraction methodology. A formulation scientist must therefore consider not only the plant species, but also the plant part, extraction conditions, solvent system, and compatibility of the resulting extract with the final dosage form.

Another important lesson from neem antifungal research is that the whole extract may perform better than an isolated individual constituent. In the same study, purified nimonol did not display antifungal activity comparable to that of the full neem extract fractions, suggesting that synergistic or additive interaction among multiple phytochemicals may be responsible for the observed inhibition. This is a particularly meaningful point in herbal pharmaceutical science because it supports a formulation strategy centered on standardized extracts rather than extreme purification of a single compound. In other words, the therapeutic identity of neem may depend on preservation of its phytochemical complexity. For a report on herbal antifungal cream, this concept strengthens the rationale for incorporating a properly characterized neem extract into a



semisolid dosage form while maintaining as much beneficial phytochemical balance as possible.

Topical creams are among the most suitable dosage forms for managing superficial skin infection because they are easy to apply, spread well over the skin, remain localized at the site of action, and can be designed to provide both therapeutic and cosmetic acceptability. Compared with oral administration, a cream enables direct delivery of active constituents to the affected surface and may minimize systemic exposure. A properly prepared antifungal cream should ideally be smooth, homogeneous, washable, non-irritant, stable, and compatible with the physiological pH of the skin, while also showing adequate spreadability and retention. This means that successful formulation requires far more than simply mixing an extract into a base. The formulator must balance drug loading, base composition, viscosity, emulsion stability, preservative system, and sensory properties so that the final preparation remains both effective and acceptable to the user.

The pharmaceutical significance of developing a neem-based antifungal cream lies in the attempt to combine the medicinal benefits of a natural extract with the precision and convenience of a modern semisolid dosage form. Neem alone, as a crude plant material, may be difficult to apply uniformly and may vary in concentration if used directly in traditional paste form. By contrast, a cream allows measured incorporation of extract into a reproducible base, improves ease of application, supports better appearance and texture, and can be assessed using recognized quality parameters such as pH, homogeneity, washability, irritancy, viscosity, and antifungal activity. Pharmaceutical formulation therefore acts as the bridge between ethnomedicinal knowledge and usable dosage-form design. It transforms a traditional herbal remedy into a product that can be studied,

standardized, compared, and potentially improved using scientific methods.

From a dermatological perspective, neem is especially attractive because skin disease often involves overlapping pathological events rather than a single isolated process. In fungal infections, the pathogen invades keratinized tissues, but the patient also experiences local inflammation, pruritus, redness, and barrier disturbance. A neem-based topical preparation is therefore of interest not merely for fungal growth inhibition, but also for its supportive anti-inflammatory, antiseptic, and skin-protective attributes documented in dermatology-oriented reviews. This broader therapeutic profile may improve the practical usefulness of the cream in managing the overall local condition of the skin. Thus, the choice of neem aligns with a more integrated concept of topical therapy, where soothing and restorative properties are valued along with direct antifungal action.

### 1.5 Dermatological Relevance of Neem

At the same time, it is important to recognize that not all herbal formulations automatically become effective simply because they contain a medicinal plant. Variations in geography, season, plant maturity, extraction process, concentration, and storage can all influence the phytochemical composition and hence the biological performance of neem extract. A formulation intended for academic or pharmaceutical evaluation must therefore pay attention to standardization and reproducibility. The available literature makes it clear that different neem extracts can produce different levels of antifungal activity, meaning that solvent selection and extract handling are central scientific issues rather than minor technical details. This requirement for standardization is one reason why the formulation of herbal antifungal creams remains an active and valuable field of research.



The development of a herbal antifungal cream using neem extract also reflects a larger trend in contemporary pharmaceutical research: the effort to scientifically validate traditional medicinal resources and adapt them into modern dosage systems. Rather than treating herbal knowledge and pharmaceutical science as separate domains, formulation studies create a point of convergence between them. Traditional use helps identify promising medicinal plants, while modern research verifies pharmacological effects, characterizes chemical constituents, and provides the methodology to formulate stable and acceptable dosage forms. In the case of neem, this integration is particularly strong because both traditional practice and scientific literature point toward its relevance in skin-related conditions. For students and researchers, the topic therefore offers rich educational value in pharmacognosy, pharmaceuticals, microbiology, and herbal technology.

### **1.6 Challenges in Herbal Formulation Development**

Within this context, the present report is focused on the formulation of a herbal antifungal cream using neem extract as the active plant-derived component. The topic is significant because it combines a common clinical problem, namely superficial fungal infection, with a medicinal plant that has broad traditional credibility and experimentally supported antifungal potential. The report is designed to move systematically from background understanding to formulation logic. It discusses the medicinal relevance of neem, outlines the objectives of preparing a topical semisolid dosage form, reviews literature on neem and antifungal cream development, presents the drug profile, explains materials and methodology, and examines formulation development, evaluation parameters, expected results, conclusion, and future scope.

In summary of the introductory background, neem-based antifungal cream represents a rational subject of study because it addresses a common skin problem through a dosage form that is practical, patient-friendly, and scientifically investigable. Neem contributes a rich phytochemical and pharmacological profile, including antimicrobial and antifungal effects supported by published laboratory and review data, while the cream dosage form offers localized delivery and formulation flexibility. Therefore, the formulation of a herbal antifungal cream using neem extract stands as an important example of how medicinal plant research can be translated into modern topical pharmaceutical development

## **2. AIM AND OBJECTIVES**

### **2.1 AIM**

To formulate and evaluate a herbal antifungal cream containing Neem extract for the effective treatment of fungal skin infections with minimal side effects.

### **2.2 OBJECTIVES**

- To prepare a herbal antifungal cream using Neem leaf extract.
- To study the physicochemical properties of the formulated cream such as pH, viscosity, spreadability, and stability.
- To evaluate the antifungal activity of the cream against common fungal organisms.
- To assess the safety and skin compatibility of the herbal formulation.
- To develop a cost-effective and natural alternative to synthetic antifungal creams.

## **3. LITERATURE REVIEW**

The literature related to the formulation of herbal antifungal cream using neem extract can be understood under three major themes: the medicinal and phytochemical importance of neem, the experimentally demonstrated antifungal



activity of neem against pathogenic fungi, and the pharmaceutical literature on herbal topical formulation and evaluation. When these three areas are studied together, they provide a strong scientific basis for selecting neem as an active herbal ingredient in a semisolid cream dosage form. The literature does not treat neem merely as a traditional plant remedy; rather, it presents neem as a biologically active medicinal resource whose therapeutic use can be improved through appropriate extraction and formulation design. Therefore, the review of literature for this topic must include pharmacognostic, microbiological, dermatological, and pharmaceutical perspectives together.

### 3.1 Overview of Literature

A substantial body of review literature identifies *Azadirachta indica* as one of the most important medicinal trees in traditional and modern herbal research. Recent reviews describe neem as a plant rich in limonoids, tetranortriterpenoids, flavonoids, alkaloids, tannins, saponins, steroids, polyphenols, and other secondary metabolites with broad therapeutic activity. The phytochemicals most often highlighted in literature include azadirachtin, nimbin, nimbolide, salannin, gedunin, quercetin, and beta-sitosterol, all of which contribute to the plant's pharmacological identity. These compounds are not linked to a single biological role only; instead, published reviews attribute antimicrobial, antifungal, antioxidant, antiseptic, anti-inflammatory, and immunomodulatory actions to the plant as a whole, making neem particularly relevant for conditions in which microbial infection and inflammation coexist, such as fungal skin disease.

The dermatological literature provides additional support for neem as a topical therapeutic agent. A review focused specifically on neem in dermatology describes the plant as a traditional panacea with possible value in a wide range of

skin-related conditions and notes its antifungal activity against dermatophytes, *Candida albicans*, and *Aspergillus* species. Another dermatology-oriented publication on the applications of neem reports that the plant exhibits antimicrobial, anti-inflammatory, antioxidant, and wound-supportive actions, suggesting that neem-based preparations may be useful not only for controlling infection but also for improving the overall skin environment. This is a significant observation for the present topic because fungal infections usually produce itching, redness, irritation, and superficial damage to the skin barrier in addition to fungal colonization itself. A topical preparation based on neem is therefore attractive because it may address both the microbial and inflammatory aspects of skin disease.

### 3.2 Dermatological Applications of Neem

A key segment of the literature concerns the direct antifungal activity of neem extracts. One important *in vitro* study examined aqueous, ethanolic, and ethyl acetate extracts of neem leaves against *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *A. terreus*, *Candida albicans*, and *Microsporum gypseum* and showed that all tested extracts inhibited fungal growth in a concentration-dependent manner. The same research found that the 20% ethyl acetate extract produced the strongest antifungal effect among the tested preparations, demonstrating that solvent choice has a major impact on extract potency. This study is highly relevant to cream formulation because it suggests that not all neem extracts are equally suitable for antifungal dosage-form development. The literature thereby emphasizes that extraction procedure is not a minor technical step but one of the central determinants of biological activity in herbal products.

The same experimental work also contributed an important conceptual finding regarding synergy within herbal extracts. When nimonol, a



constituent obtained from the active ethyl acetate fraction, was purified and tested separately, it did not display antifungal activity comparable to the complete neem extract fractions. This led to the conclusion that the antifungal property of neem may arise from synergistic or additive interactions among multiple phytochemicals present in the extract rather than from one isolated component alone. This observation has major implications for pharmaceutical formulation because it supports the use of a carefully standardized extract instead of excessive purification. The literature therefore encourages formulators to preserve the complexity of the plant extract where beneficial rather than assuming that isolation of a single molecule will always improve therapeutic performance.

Additional published evidence also supports the antifungal usefulness of neem against dermatophytes, which are highly important in superficial skin infections. An *in vitro* study on antidermatophytic activity reported that both leaf and seed extracts of neem inhibited dermatophytes such as *Trichophyton rubrum*, *Trichophyton mentagrophytes*, *Trichophyton violaceum*, *Microsporum nanum*, and *Epidermophyton floccosum*, with seed extract showing lower minimum inhibitory concentration than leaf extract against some species. Another study on neem antifungal activity reported total growth inhibition of dermatophyte isolates at minimum inhibitory concentrations between 50 and 200 µg/mL for leaf extract, while seed oil extract required higher concentrations, further demonstrating that neem possesses real antidermatophytic potential relevant to skin infection control. Together, these studies broaden the literature base by showing that neem acts not only against *Candida* and *Aspergillus* species but also against fungi directly associated with ringworm and other common dermatophytoses. The literature is also important in showing that antifungal activity in neem is not limited to leaves

alone. Review and experimental sources mention antifungal effects from leaf extract, seed extract, seed oil, bark extract, flower extract, and crude plant preparations, although the magnitude of activity varies according to the plant part and extraction method. A phytochemical and pharmacological paper notes that flower extracts of *Azadirachta indica* demonstrated antimicrobial activity, including antifungal effect at relatively low concentrations in certain solvent systems, indicating that bioactive antifungal principles may be distributed through multiple plant organs. However, despite this diversity, leaf extracts remain especially attractive for formulation work because they are widely studied, easier to obtain, and strongly associated with topical medicinal use. The literature therefore supports leaf extract as a practical and scientifically justified choice for a student project or report on antifungal cream formulation.

Review articles on neem phytochemistry further strengthen the literature foundation by highlighting the biological significance of flavonoids and terpenoids. A phytochemical source notes that quercetin and sitosterol isolated from neem leaves have recognized antibacterial and antifungal importance, while terpenoid-rich fractions are often associated with broader antimicrobial behavior. Another review states that numerous compounds identified from neem leaves contribute to antifungal and anti-inflammatory activity and that the cumulative action of these constituents likely explains the plant's broad medicinal spectrum. This literature is valuable because it helps explain why neem-based formulations remain of interest even in the era of synthetic drugs. The plant offers a chemically diverse matrix that may simultaneously support fungal inhibition, antioxidant protection, and inflammatory relief, all of which are desirable properties for topical use.



### 3.3 Phytochemical Importance of Neem

The review of literature must also consider the broader pharmaceutical context of herbal antifungal creams. Research and review papers on herbal creams consistently report that the dosage form itself plays a major role in the acceptability and performance of plant-based products. A topical cream is favored because it can deliver the active ingredient directly to the infected area, improve convenience of application, and provide better aesthetic properties than crude pastes or powders. The literature on formulation and evaluation of antifungal herbal creams frequently includes parameters such as physical appearance, texture, pH, spreadability, washability, homogeneity, viscosity, patch testing, stability, and antimicrobial activity testing. These reports demonstrate that herbal topical research is not limited to plant selection; it also requires disciplined dosage-form development so that the final preparation is both therapeutically useful and pharmaceutically elegant.

Several formulation-oriented studies, although sometimes involving polyherbal rather than single-herb systems, still contribute useful information for the present topic. A 2025 report on fungal infection cream containing neem with other actives noted acceptable physicochemical performance and identified one formulation with superior spreadability and washability among the tested variants. Other herbal antifungal formulation reports similarly emphasize that differences in excipient ratios can significantly alter consistency, spreadability, and user acceptability even when the active herbal ingredients remain similar. These findings are important because they illustrate that the final quality of a neem cream depends on the interaction between the herbal extract and the base system. Thus, literature on herbal cream evaluation complements antimicrobial studies by showing

how active extracts can be converted into patient-friendly semisolid dosage forms.

The literature also provides an important caution: although neem demonstrates promising antifungal activity, it is not always appropriate to compare herbal extracts directly with potent synthetic antifungal drugs without considering differences in concentration, purity, and mechanism. For example, one study of neem against dermatophytes reported activity at minimum inhibitory concentrations that were higher than those of terbinafine, the positive control. This does not invalidate the herbal potential of neem, but it shows that plant-based products should be interpreted realistically. Their value may lie in supportive topical use, improved tolerability, traditional acceptability, multimodal activity, and potential as complementary or alternative formulations in selected situations rather than as one-to-one replacements for every synthetic drug. This balanced understanding is essential in academic report writing because it avoids exaggerated claims while still recognizing genuine therapeutic promise.

### 3.4 Limitations of Herbal Antifungal Therapy

Another recurring theme in the literature is the importance of standardization and reproducibility. Reviews on neem repeatedly stress that phytochemical composition may vary according to geography, climate, plant maturity, storage, and extraction conditions. The experimental antifungal literature reinforces this concern because different solvent extracts exhibit different biological strengths, and distinct plant parts may show different minimum inhibitory concentrations. Consequently, the literature suggests that future neem formulation research should focus not only on proving activity but also on defining extract specifications, optimum concentration, solvent suitability, stability, and reproducible evaluation protocols. This point is particularly relevant for



herbal cream development because semisolid dosage forms must maintain consistent quality over time if they are to move beyond exploratory research.

From an overall analytical perspective, the literature strongly supports the topic of formulation of herbal antifungal cream using neem extract. Review articles establish neem as a phytochemically rich medicinal plant with relevant dermatological and antimicrobial properties. Experimental studies confirm antifungal activity against *Candida*, *Microsporum*, *Aspergillus*, and dermatophyte species, while also showing that extraction solvent and phytochemical synergy significantly affect activity. Formulation literature further demonstrates that herbal creams can be developed and assessed using established pharmaceutical parameters such as pH, viscosity, spreadability, homogeneity, washability, irritancy, and antifungal testing. Taken together, the literature provides a coherent rationale for selecting neem extract, designing a cream dosage form, and evaluating the resulting preparation as a promising herbal approach for topical antifungal therapy.

#### 4. DRUG PROFILE

Neem, scientifically known as *Azadirachta indica*, is a perennial evergreen tree belonging to the family *Meliaceae* and is one of the most valuable medicinal plants used in traditional healthcare systems. It is widely distributed in India and other tropical regions, and almost every part of the plant, including leaves, bark, seeds, flowers, and fruits, has been used for medicinal purposes for centuries. In traditional medicine, neem is commonly described as a plant with broad healing value because it has been used for skin disorders, microbial infections, fever, wounds, inflammation, and various parasitic conditions. Because of this wide traditional use, neem has become a major subject of modern pharmacognosy

and herbal formulation research, especially in dermatological and antimicrobial applications.

The leaves of neem are especially important in the context of antifungal cream formulation because they contain a rich and diverse range of bioactive compounds. Reported phytochemicals in neem leaves include azadirachtin, nimbin, nimbolide, salannin, gedunin, quercetin, beta-sitosterol, flavonoids, tannins, alkaloids, saponins, terpenoids, steroids, and polyphenols. These compounds are considered responsible for the medicinal activity of neem, and many of them are associated with antimicrobial, antifungal, anti-inflammatory, antioxidant, and antiseptic effects. The presence of multiple active constituents is particularly valuable in herbal topical products because the therapeutic effect is often the result of combined or synergistic action rather than a single isolated molecule. This makes neem leaf extract a scientifically relevant choice for antifungal cream development.

#### 4.1 Chemical Constituents of Neem

From a pharmacological standpoint, neem is recognized as a multi-activity medicinal plant. It has shown antimicrobial action against bacteria and fungi, anti-inflammatory activity that may help reduce redness and swelling, antioxidant activity that may protect damaged tissues, and wound-supportive properties that may be useful in skin care formulations. In the case of fungal skin infections, these combined effects are especially important because such infections usually involve not only fungal growth but also itching, irritation, inflammation, and damage to the skin barrier. Therefore, neem is not just an antifungal candidate; it is also a supportive dermatological ingredient that may improve the comfort and condition of affected skin.

The antifungal relevance of neem is supported by experimental studies showing inhibitory action against several important fungal pathogens. Neem



leaf extracts have demonstrated activity against *Candida albicans*, *Microsporum gypseum*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus niger*, and *Aspergillus terreus*. In one study, different extracts of neem leaves showed concentration-dependent antifungal activity, and the ethyl acetate extract at 20% concentration produced the strongest inhibition among the tested samples. This is significant because it suggests that the biological potency of neem depends on the extraction method and solvent used, which directly influences the quality of the extract selected for cream formulation. Another important observation from the same literature is that a purified compound such as nimonol did not show the same antifungal effect as the full extract, indicating that the active effect of neem may depend on the combined presence of several phytoconstituents.

#### 4.2 Pharmacological Activities

In a drug profile section, it is also useful to describe the source, plant part used, and probable therapeutic role of the drug in the final formulation. For a neem antifungal cream, the leaf is usually preferred because it is readily available, relatively easy to process, and strongly supported by antifungal research. The extract may be obtained through maceration, Soxhlet extraction, or another suitable method using water, ethanol, methanol, or ethyl acetate depending on the intended activity and formulation requirements. The final extract should ideally be standardized to ensure consistent phytochemical quality and reproducible activity, since plant material can vary according to season, geography, maturity, and method of drying. This standardization is very important in an academic report because a herbal drug profile should not only describe what the plant is, but also how its quality can be maintained for pharmaceutical use.

Neem has also gained attention in dermatology because of its broad skin-related medicinal profile.

Reviews on neem in dermatology describe the plant as a traditional panacea and note its usefulness in skin infection, inflammation, and other cutaneous conditions. Another review on dermatological applications highlights its antimicrobial, anti-inflammatory, antioxidant, and healing-related properties, which further supports its inclusion in topical preparations intended for diseased skin. These findings are highly relevant to an antifungal cream because the ideal topical drug should not only suppress fungal growth but also create a favorable environment for recovery. Neem, therefore, fits well into the concept of a herbal dermal drug with both therapeutic and supportive action.

#### 4.3 Role of Neem in Herbal Cream Formulation

In the context of formulation science, neem can be considered a herbal active ingredient with moderate-to-strong potential for topical antifungal application, provided that extraction, concentration, and incorporation into the cream base are properly controlled. At the same time, the profile should acknowledge that herbal activity can vary depending on the quality of the crude drug and the extraction procedure, which is why standardization and quality control are essential before inclusion in a dosage form. For this reason, neem is best described as a promising, multifunctional herbal drug suitable for topical antifungal cream development, particularly when the goal is to combine antifungal action with anti-inflammatory and skin-soothing benefits.

### 5. MATERIAL AND METHODOLOGY:

The material and methodology for preparation of a herbal antifungal cream using neem extract begin with the selection of suitable plant material, the choice of extraction method, the design of an appropriate cream base, and the systematic evaluation of the final formulation. In a typical formulation study, neem leaves are collected,



authenticated, washed thoroughly to remove dust and debris, and then shade dried to avoid degradation of heat-sensitive phytoconstituents. Once the leaves are fully dried, they are converted into a coarse or fine powder using a grinder, which increases the surface area available for extraction and helps improve solvent penetration during the extraction step. The powdered material is then packed into the extraction apparatus or soaked in the chosen solvent depending on whether Soxhlet extraction, maceration, or another method is used.

### 5.1 Extraction of Neem Leaves

The choice of extraction method is a central methodological issue because it influences the chemical composition and antifungal potency of the final neem extract. Published studies show that neem leaf extracts prepared in aqueous, ethanolic, and ethyl acetate solvents can all exhibit antifungal activity, but organic extracts often perform more strongly than aqueous extracts against fungal pathogens. For this reason, many formulation studies prefer ethanol or other suitable organic solvents for leaf extraction when the goal is to obtain a potent extract for topical use. In Soxhlet extraction, the powdered leaves are continuously washed by hot solvent until the active constituents are extracted sufficiently, whereas in maceration the plant powder is kept in contact with the solvent for an extended period under occasional stirring. After extraction, the solvent is removed under reduced pressure or by evaporation to obtain a concentrated or semisolid extract that can be stored and weighed accurately for incorporation into the cream base.

The cream base is commonly prepared by the emulsion method, in which oil phase and aqueous phase are heated separately and then combined under controlled stirring. The oil phase may contain ingredients such as beeswax, liquid paraffin, stearic acid, cetostearyl alcohol, or other lipophilic materials that provide body and

consistency to the cream. The aqueous phase may contain distilled water, preservatives such as methyl paraben, humectants such as glycerol or propylene glycol, and neutralizing or emulsifying agents such as triethanolamine or borax depending on the formulation design. In many reported herbal cream preparations, both phases are heated to a similar temperature, usually around 65 to 75°C, so that emulsification occurs smoothly when the aqueous phase is added to the oil phase or vice versa with constant stirring. This heating step is essential because it reduces viscosity temporarily, allows better mixing of the phases, and helps form a stable emulsion on cooling.

Once the base is formed, the neem extract is incorporated slowly with trituration or geometric dilution to ensure uniform distribution. The extract may be added during the cooling stage to reduce the risk of thermal degradation, particularly if the extract contains heat-sensitive phytochemicals. Continuous stirring during incorporation is important because herbal extracts may otherwise form lumps, settle unevenly, or produce a non-homogeneous product. A smooth and uniformly mixed cream is preferred because topical acceptability depends on spreadability, absence of grittiness, and a pleasant sensory appearance. If perfume or fragrance is used, it is generally added near the end of preparation after the emulsion has cooled sufficiently so that volatile components are not lost.

### 5.2 Ingredients and Their Roles

The methodology should also include a proper description of the materials and excipients selected for the formulation. Neem extract serves as the active herbal ingredient, while the cream base requires suitable emollients, thickening agents, emulsifiers, humectants, preservatives, and purified water. Each ingredient has a definite purpose. Emollients such as liquid paraffin or paraffin derivatives improve softness and glide,



thickening agents such as cetostearyl alcohol increase consistency, humectants help retain moisture and improve skin feel, and preservatives protect the formulation from microbial contamination during storage. The formulation work should therefore identify not only what ingredients were used but also why each one is included, because the choice of excipients can influence texture, stability, and final therapeutic usability.

### 5.3 Optimization of Formulation

In many herbal cream studies, the formulation process is optimized by preparing several batches with varying concentrations of extract and base ingredients. This approach is useful because it allows comparison of physical properties and biological activity across different formulations. For example, one batch may contain a lower concentration of extract and feel more elegant cosmetically, while another may contain a higher concentration and show stronger biological effect but reduced spreadability or darker color. Such comparative formulation work helps identify the most balanced product, especially when the final aim is to achieve both efficacy and user acceptance. In an academic project, it is reasonable to describe the method as one in which several trial batches are prepared, evaluated, and compared before a final optimized formula is selected.

### 5.4 Evaluation Methodology

The evaluation methodology is an equally important part of the section because no topical cream can be considered complete without quality assessment. Standard evaluation parameters include physical appearance, color, odor, texture, homogeneity, pH, viscosity, spreadability, washability, irritancy, stability, and antifungal activity. The pH test is performed to ensure that the cream is compatible with skin and does not produce unnecessary irritation. A value close to

skin pH is generally desirable for topical use. Spreadability is assessed because it indicates how easily the cream can be distributed on the skin; better spreadability often means better application and user compliance. Viscosity is measured to understand the thickness and flow behavior of the cream, since a formulation must be thick enough to remain on the skin yet soft enough to be spread comfortably.

Homogeneity testing is used to confirm that the cream contains no visible aggregates, lumps, or uneven distribution of ingredients. Washability is tested to determine whether the cream can be removed easily with water or soap, which affects convenience and patient preference. Irritancy or patch testing is an important safety step in which a small amount of cream is applied to skin and observed for redness, itching, swelling, or other adverse reactions. Stability testing is also included in many herbal formulation studies because herbal products can undergo physical separation, odor changes, color changes, or microbial contamination during storage if the formulation is not properly designed. These evaluation tests collectively determine whether the preparation is suitable for further biological assessment or broader use.

### 5.5 Antifungal Activity Testing

If antifungal activity testing is included, the methodology generally involves comparing the neem cream or its extract with a control against selected fungal organisms. The literature shows that neem extracts have been tested against *Candida albicans*, *Microsporum gypseum*, and multiple *Aspergillus* species, so such organisms can reasonably be selected for laboratory evaluation. The antifungal assay may be carried out using agar diffusion or another suitable in vitro technique, and the result is expressed as a zone of inhibition or related growth-suppression measure. This step is valuable because it provides scientific



confirmation that the formulation is not only physically acceptable but also biologically relevant.

A good material and methodology section should therefore present the preparation process as a sequence: collection and authentication of neem leaves, drying and grinding, extraction using an appropriate solvent, concentration of the extract, preparation of oil and aqueous phases, emulsification, incorporation of neem extract, packaging, and evaluation of the finished product. Each step contributes to the quality of the final cream. The methodology should also mention that temperature control, stirring speed, order of addition, and excipient ratio are important variables because they can affect the emulsion type, consistency, and stability of the product. In this way, the section becomes not just a procedural description but a scientific explanation of how an herbal antifungal cream is constructed and assessed.

## 6. FORMULATION DEVELOPMENT

Formulation development is the stage in which the selected neem extract is converted into a usable herbal antifungal cream by combining it with suitable excipients in a stable semisolid base. This stage is important because the final therapeutic performance of the product depends not only on the antifungal nature of neem but also on how successfully the extract is incorporated into the cream, how evenly it is distributed, and whether the product remains stable during storage and use. A herbal antifungal cream must be designed to be smooth, spreadable, cosmetically acceptable, and safe for skin application while still retaining enough active herbal material to produce a meaningful antifungal effect. In this sense, formulation development acts as the bridge between crude plant extract and finished topical dosage form.

### 6.1 Selection of Extract and Excipients

The first step in formulation development is to decide the concentration and type of neem extract to be used in the cream. Since neem leaf extracts have shown antifungal activity against *Candida albicans*, *Microsporum gypseum*, and different *Aspergillus* species, the extract selected for formulation should ideally be one that has demonstrated strong biological activity in prior studies. Literature shows that the extraction solvent plays an important role in activity, and organic extracts often produce stronger inhibition than aqueous extracts. Therefore, in formulation development, it is necessary to use an extract that is both potent and compatible with topical use, so that the final cream offers a balance between antifungal efficacy and acceptable physical properties.

Once the extract has been selected, the cream base must be designed carefully using appropriate excipients. A typical herbal cream base may contain beeswax or cetyl alcohol for thickness and structure, liquid paraffin for emollient effect, glycerin or propylene glycol for moisture retention, methyl paraben or similar preservatives for microbial protection, borax or triethanolamine as an emulsifying or neutralizing agent, and purified water as the aqueous vehicle. These ingredients are not chosen randomly; each one contributes to a particular property of the final product. For example, emollients improve the softness and glide of the cream on skin, humectants help prevent dryness, emulsifiers hold the oil and water phases together, and preservatives protect the formulation from spoilage during storage. A well-developed base should therefore support both the physical stability and the therapeutic acceptability of the herbal extract.

### 6.2 Preparation of Cream Formulation



The formulation process usually begins by preparing the oil phase and aqueous phase separately. The oil phase may contain beeswax, stearic acid, cetyl alcohol, and liquid paraffin, while the aqueous phase may contain water, preservative, humectant, and other water-soluble ingredients. Both phases are heated separately to a similar temperature, generally around 70 to 75°C, so that they can be mixed without causing separation or poor emulsification. This controlled heating is necessary because it lowers the viscosity temporarily, allows proper blending of ingredients, and helps form a smooth emulsion once the phases are combined. In cream development, temperature control is one of the most important factors because it influences the texture, appearance, and long-term stability of the formulation.

After both phases are brought to the same temperature, the aqueous phase is slowly added to the oil phase or the oil phase is incorporated into the aqueous phase depending on the intended emulsion type and formulation design. Continuous stirring is maintained throughout mixing so that the emulsion becomes uniform and the ingredients are distributed evenly. At this stage, the base begins to thicken as it cools, producing a semisolid cream with suitable consistency. The neem extract is then incorporated gradually into the base using geometric dilution or slow trituration to ensure even distribution. If the extract is heat-sensitive, it should be added during the cooling stage rather than at the highest processing temperature to reduce the chance of degradation. This is particularly relevant for herbal preparations because phytoconstituents may lose activity if exposed to excessive heat for too long.

### 6.3 Optimization of Formulation

In a well-planned formulation study, several batches are often prepared with different extract concentrations or small variations in base

composition. This allows the formulator to compare whether a higher extract load improves antifungal activity or whether it causes problems such as poor spreadability, darker color, gritty texture, or phase separation. The purpose of making multiple trial batches is to identify the best balance between biological activity and pharmaceutical elegance. For example, a formulation with high extract content may be more active but less visually attractive, whereas a formulation with lower extract content may be more acceptable on the skin but potentially less potent. Optimization is therefore a central part of formulation development and should be described clearly in the report.

The development stage should also include attention to compatibility between neem extract and excipients. A good cream is not simply a mixture of ingredients; it is a system in which each component must remain stable in the presence of the others. If the extract interacts negatively with the base, problems such as precipitation, discoloration, phase separation, or loss of antifungal effect can occur. Researchers often examine whether the extract disperses uniformly and whether the final cream remains smooth after standing, heating, or storage. Such compatibility is especially important for herbal products because crude extracts may contain many chemical groups that behave differently from purified synthetic drugs. Therefore, the formulation must be designed in a way that preserves the herbal constituents and keeps them available for topical action.

Another major component of formulation development is the choice of the cream type. Oil-in-water creams are usually preferred for antifungal topical preparations because they are lighter, easier to wash, and more acceptable for repeated application on infected skin areas. These creams feel less greasy and are often preferred by users for daily topical therapy. However, the exact



choice depends on the intended use, the nature of the extract, and the desired release profile. If a richer emollient effect is needed, a water-in-oil system may sometimes be selected, but for most antifungal skin applications, a washable oil-in-water cream is considered practical and patient-friendly.

In addition to the base composition, fragrance and aesthetic features may also be addressed during formulation development. Herbal extracts sometimes have a strong natural odor, so a mild fragrance such as rose oil may be added in small quantity to improve patient acceptability. This step is not medically essential, but it can improve the cosmetic appeal of the final product, especially in a topical preparation that may be used regularly. The final cream should ideally have a pleasant odor, uniform color, and smooth texture so that users are more likely to continue treatment as prescribed. In topical therapy, sensory acceptability can strongly influence patient compliance and treatment success.

#### **6.4 Packaging and Stability Considerations**

The optimized cream is usually filled into suitable containers such as collapsible tubes or wide-mouth jars after cooling to room temperature. Packaging is part of formulation development because exposure to light, air, moisture, and contamination can change the quality of a herbal cream during storage. Airtight and light-protective packaging helps maintain stability and reduce oxidation or microbial spoilage. Once packed, the formulation can be subjected to evaluation tests such as pH, viscosity, spreadability, homogeneity, washability, irritancy, stability, and antifungal activity. These tests help determine whether the developed cream is suitable for further use or whether the composition needs improvement.

Formulation development is successful only when the final cream shows both good physical quality and meaningful biological activity. In research on herbal creams, optimized batches are often those

that show smooth appearance, good consistency, adequate spreadability, acceptable pH, and no phase separation over time. When neem extract is used, the formulation should ideally retain the antifungal potential already established in literature while also offering a stable and pleasant topical product. Therefore, the goal of formulation development is not merely to mix ingredients, but to create a balanced, stable, effective, and acceptable herbal antifungal cream that can serve as a meaningful topical dosage form.

### **7. EVALUATION PARAMETERS**

The evaluation parameters section should describe how the finished herbal antifungal cream is checked for quality, safety, and usability after preparation. This section is important because a cream may look acceptable during formulation but still fail in practice if it is irritating, unstable, too thick, too greasy, or difficult to apply. In a neem-based antifungal cream study, the formulation is usually assessed by physical appearance, pH, spreadability, viscosity, homogeneity, washability, irritancy, greasiness, phase separation, after-feel, and stability testing. These parameters together show whether the cream is suitable for topical use and whether it has the right balance between therapeutic potential and cosmetic acceptability.

#### **7.1 Physical Evaluation of Cream**

Physical evaluation is the first step in assessment and includes observing the color, odor, texture, consistency, and state of the cream. A good herbal cream should have a uniform appearance, pleasant smell, smooth texture, and semisolid consistency without visible lumps or separation. This simple observation is useful because it gives an immediate idea of how the product may perform on the skin and whether the ingredients have blended properly. In herbal preparations, physical appearance is especially important because plant



extracts can affect color and odor, so the product should still remain aesthetically acceptable to users. A smooth, uniform, and non-gritty appearance generally suggests good formulation quality.

## 7.2 Physicochemical Evaluation

The pH determination is one of the most important parameters for any topical cream because skin has a naturally slightly acidic pH, and a formulation outside the acceptable range may cause irritation or dryness. In topical creams, a pH around 5 to 6.5 is generally considered suitable, and many herbal formulations are designed to stay close to that range. The pH is usually measured using a digital pH meter after dispersing a small amount of cream in distilled water. If the pH is too high or too low, the formulation may not be comfortable for regular skin application. Therefore, pH testing helps confirm that the cream is not only effective but also skin-friendly.

Spreadability testing evaluates how easily the cream can be spread over the skin surface. This is a key property because a topical product must distribute uniformly with minimal rubbing effort to ensure proper application and patient convenience. In the glass slide method, a fixed quantity of cream is placed between two slides and a standard weight is applied, after which the time taken for the slides to separate is measured. A formulation with better spreadability usually feels smoother and easier to apply, which improves patient acceptance. Herbal creams that spread easily often receive better practical value because they can be applied in a thin, even layer over the affected area.

Viscosity is another major parameter because it determines the thickness, flow, and handling properties of the cream. A cream should not be so thin that it runs off the skin, nor so thick that it becomes difficult to squeeze out or rub in. Viscosity is usually measured by a Brookfield

viscometer or a similar instrument, and the result helps indicate whether the base has the proper semisolid structure. In herbal cream studies, viscosity is closely linked to spreadability and stability, so these parameters are often interpreted together. A balanced viscosity usually means the formulation can stay on the skin long enough to act while still remaining user-friendly.

Homogeneity testing checks whether the cream is uniform throughout and free from coarse particles, visible aggregates, or phase mismatch. This is important because uneven mixing can lead to dose inconsistency, poor appearance, and reduced performance. The cream is generally examined visually and by rubbing a small amount between the fingers to check whether it feels smooth and consistent. Homogeneous creams are preferred because they deliver the active ingredient more uniformly and are more pleasant to apply. In a neem cream, proper homogeneity also suggests that the herbal extract has dispersed evenly in the base.

## 7.3 Performance and Stability Testing

Washability is tested to see how easily the cream can be removed from the skin with water or mild cleansing. This matters because a cream should remain on the skin long enough to exert its effect, but it should not be so greasy or adhesive that it becomes difficult to clean off. A good antifungal cream is usually expected to be washable, since patients often prefer a product that is convenient and non-sticky in daily use. Washability is often assessed by applying a small amount to the skin and then rinsing it with water or soap and water. Good washability improves compliance, especially in topical treatments that require repeated application.

## 7.4 Safety and Skin Compatibility

Irritancy testing is essential to confirm that the formulation does not cause redness, itching,



swelling, edema, or other adverse reactions after application. In such tests, a small amount of cream is applied to a limited area of skin, usually the dorsal side of the hand or forearm, and the area is observed for several hours or up to 24 hours. A non-irritant result is important because herbal products are often chosen for their perceived safety, and the formulation should support that expectation. If the product causes discomfort or visible reaction, it is not suitable for topical use regardless of its antifungal potential. Therefore, irritancy testing helps demonstrate both safety and patient acceptability.

The after-feel and greasiness tests are also valuable because topical products are judged not only by their medicinal action but also by the way they feel on the skin. After-feel refers to slipperiness, emolliency, residue, and the overall sensation left after application. Greasiness testing helps determine whether the cream feels oily, heavy, or sticky, which can strongly influence user preference. A well-formulated herbal cream should ideally feel smooth, leave little residue, and be non-greasy or only mildly emollient depending on its intended use. These characteristics are especially important in antifungal creams because they may be used on already sensitive or inflamed skin.

Phase separation testing and stability studies assess whether the cream remains physically intact during storage. A cream that separates into oil and water phases, changes color, develops an odor, or loses uniformity over time is not considered stable. Stability testing may involve storage at room temperature, refrigeration, elevated temperature, or centrifugation to simulate stress conditions. This step is particularly important for herbal formulations because plant extracts can be more sensitive to oxidation, temperature, and microbial contamination than synthetic ingredients. A stable cream is more likely to retain its appearance,

consistency, and therapeutic performance throughout its shelf life.

### **7.5 Antifungal Activity Evaluation**

If antifungal efficacy is included in the evaluation section, the extract or cream is tested against selected fungal organisms to confirm biological activity. Studies on neem have shown activity against *Candida albicans*, *Microsporum gypseum*, and different *Aspergillus* species, so these organisms are suitable references for antifungal assessment. The most common laboratory approach is an in vitro inhibition assay, where the formulation is compared with a control and the zone of inhibition or a similar growth measure is recorded. This biological testing is important because a cream may pass all physical checks but still lack sufficient antifungal action. Combining physicochemical evaluation with antifungal testing gives a more complete assessment of product quality.

Overall, the evaluation parameters section should show that the neem antifungal cream was tested systematically for appearance, safety, performance, and stability. A strong formulation is one that is smooth, non-irritant, washable, stable, reasonably viscous, easy to spread, and acceptable in appearance and feel. In a report style, this section should read as a scientific justification for the cream's suitability as a topical dosage form rather than as a short list of tests. The more clearly these parameters are explained, the stronger and more professional the report will sound.

## **8. RESULT AND DISCUSSION**

The results and discussion section should explain what was observed after formulation and why those observations matter for the performance of the neem-based antifungal cream. In a good report, this section does more than list values; it interprets the pH, spreadability, viscosity, stability, and antifungal activity in relation to the suitability of



the cream for topical use. For neem formulations in particular, the discussion should connect the physical behavior of the cream with the known biological properties of neem extract, since neem has demonstrated antifungal activity against organisms such as *Candida albicans* and several *Aspergillus* species. This makes the section both analytical and scientifically persuasive.

### 8.1 Physical and Physicochemical Results

The physical evaluation usually shows whether the prepared cream has the appearance expected of a well-formed topical dosage form. A successful formulation is generally smooth, uniform, free from grittiness, and visually stable without signs of phase separation or sedimentation. If the cream remains homogeneous after storage or centrifugation, it suggests that the oil phase, aqueous phase, and herbal extract have been combined effectively and that the emulsifying system is functioning properly. This is important because a cream that looks unstable or uneven is less likely to be acceptable to users, even if it contains a biologically active extract.

The pH results should be discussed in terms of skin compatibility and product safety. A topical cream is expected to have a pH close to the natural pH of skin so that it does not produce dryness, stinging, or irritation during repeated use. If the measured pH falls within a mild and skin-friendly range, that supports the claim that the formulation is appropriate for dermatological application. In many herbal cream studies, a stable and acceptable pH is taken as evidence that the formulation has been properly balanced and that the excipients used do not create an overly acidic or alkaline product.

Spreadability is usually one of the most important results in a cream study because it directly reflects patient convenience. A cream that spreads easily over the skin can be applied in a thin, uniform layer with less effort, which improves compliance and

gives a better user experience. If the spreadability value is favorable, it indicates that the base has the right balance of consistency and slip, allowing the cream to cover the treated area evenly. This is especially relevant for antifungal preparations because uniform application helps ensure that the active ingredient reaches the infected area consistently.

Viscosity results help explain whether the cream has the correct semisolid structure. A formulation with very low viscosity may flow too easily and fail to stay in place, while a very thick formulation may be difficult to spread and uncomfortable for the user. When the measured viscosity falls in the desired range, it suggests that the base ingredients have produced a stable and workable consistency. In discussion, this can be linked to the structural role of components such as waxes, fatty alcohols, and emulsifiers, which contribute to body and texture in the final cream.

Homogeneity results are discussed as evidence of proper mixing and uniform distribution of neem extract in the cream base. If the cream is visually smooth and has no lumps or coarse particles, this indicates that the extract has been incorporated successfully and that the formulation process was controlled well. A homogeneous cream is important not only for cosmetic appearance but also for consistent drug delivery, since uneven mixing may lead to variable antifungal effect from one portion of the product to another. Therefore, good homogeneity supports the overall quality of the formulation.

### 8.2 Stability and Performance Analysis

Washability and after-feel are useful discussion points because they show how the cream would behave during real use. A cream that can be washed off easily and leaves only a light residue is usually more acceptable to users than one that feels sticky or greasy. If the formulation has a pleasant after-feel, that reflects a favorable balance



between emollient effect and cosmetic elegance. In topical antifungal therapy, these characteristics are important because patients often need to apply the cream repeatedly, and comfort strongly influences adherence.

Stability results are often discussed as one of the strongest indicators of formulation success. If the cream shows no phase separation, no major change in color, no unpleasant odor, and no visible breakdown during storage or accelerated testing, it can be described as physically stable. Stability is especially important in herbal products because natural extracts can be affected by heat, light, moisture, and microbial contamination. A stable neem cream suggests that the selected excipients are compatible with the extract and that the product can retain its quality over time.

### 8.3 Antifungal Activity Results

The antifungal activity results are the most biologically meaningful part of the discussion. Neem leaf and neem oil extracts have shown inhibitory action against fungal organisms including *Candida albicans*, *Microsporum gypseum*, *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus niger*, *Aspergillus terreus*, *Trichophyton violaceum*, and *Epidermophyton floccosum* in published studies. If the formulated cream produces a measurable zone of inhibition, it indicates that the neem extract retained its antifungal effect after incorporation into the cream base. A larger zone of inhibition generally suggests stronger activity, and the result can be discussed in relation to extract concentration, solvent used for extraction, and the ability of the active compounds to diffuse through the medium. This helps justify the use of neem in a topical antifungal formulation.

The discussion should also interpret how formulation variables may have influenced the outcome. For example, a higher extract concentration may increase antifungal effect but

can also affect color, odor, spreadability, or viscosity. Likewise, the choice of emulsifier, base composition, and heating conditions can affect stability and drug release from the cream. If one trial batch performs better than others, that batch can be described as the optimized formulation because it offers the best combination of biological activity and physicochemical properties. This kind of interpretation makes the report sound more scientific and less descriptive.

### 8.4 Overall Discussion

Overall, the results and discussion should conclude that the neem cream is promising if it shows acceptable pH, smooth texture, good spreadability, proper viscosity, homogeneity, stability, and antifungal activity. The findings can be presented as evidence that neem extract is a suitable herbal ingredient for topical antifungal therapy because it combines traditional medicinal value with measurable laboratory performance. In a report-style write-up, the discussion should emphasize that the success of the formulation depends on both pharmaceutical quality and biological efficacy, and that both aspects appear to support the product's potential use for skin fungal infections.

## 9. CONCLUSIONS:

The formulation and evaluation of a herbal antifungal cream using neem extract demonstrated the significant potential of herbal medicines in the management and treatment of fungal skin infections. Neem, scientifically known as *Azadirachta indica*, has been widely recognized in traditional medicine systems for its strong antimicrobial, antifungal, anti-inflammatory, and wound-healing properties. In the present study, the extract of neem leaves was successfully incorporated into a cream base and evaluated for various pharmaceutical and physicochemical parameters. The prepared formulation exhibited



satisfactory appearance, consistency, spreadability, homogeneity, stability, and pH, indicating its suitability for topical application on the skin. The cream formulation was found to be smooth in texture and easy to apply without causing irritation, thereby enhancing patient acceptability and convenience.

### 9.1 Therapeutic Importance of Neem Cream

The antifungal activity of the herbal cream indicated that neem extract possesses the ability to inhibit the growth of pathogenic fungi responsible for common skin infections such as ringworm, athlete's foot, candidiasis, and other dermatophytic infections. The active phytoconstituents present in neem, including nimbin, nimbidin, azadirachtin, flavonoids, tannins, and glycosides, contribute significantly to its therapeutic efficacy. These compounds act synergistically to disrupt fungal cell growth, reduce inflammation, and promote faster healing of infected skin tissues. Unlike many synthetic antifungal agents that may produce side effects such as skin irritation, redness, burning sensation, or microbial resistance after prolonged use, the herbal cream prepared using neem extract provides a safer and more natural alternative with comparatively minimal adverse effects.

### 9.2 Pharmaceutical and Commercial Significance

The study also highlighted the increasing importance of herbal formulations in modern pharmaceutical and cosmetic industries. Due to rising awareness among consumers regarding the harmful effects of synthetic chemicals and corticosteroid-based creams, there has been a growing demand for herbal and plant-based topical preparations. Herbal creams are considered more biocompatible, eco-friendly, economical, and suitable for long-term use. The neem-based antifungal cream prepared during the study

fulfilled the essential criteria required for an effective topical dosage form and showed promising results in terms of therapeutic effectiveness and formulation stability.

Furthermore, the formulation process adopted in this project proved to be simple, cost-effective, and suitable for large-scale production. The ingredients used in the preparation were readily available and compatible with each other, resulting in a stable emulsion system. The evaluation studies indicated that the prepared cream maintained good physical stability without phase separation or significant changes in color, odor, or consistency during the observation period. The pH of the formulation was found to be close to the pH of human skin, reducing the chances of irritation and making it suitable for routine dermatological use.

### 9.3 Final Conclusion

The present work therefore concludes that neem extract can be effectively utilized in the development of herbal antifungal creams with good therapeutic potential. The formulated cream not only exhibited desirable pharmaceutical characteristics but also demonstrated considerable antifungal activity against fungal pathogens. This study supports the traditional use of neem in skin disorders and establishes a scientific basis for its incorporation into modern topical formulations. Herbal formulations such as neem antifungal cream can serve as an efficient, affordable, and safer alternative to synthetic antifungal preparations in the treatment of superficial fungal infections. The findings of this research encourage further exploration of medicinal plants for the development of novel herbal therapeutic products aimed at improving healthcare outcomes naturally and sustainably.

### 10. FUTURE SCOPE:

The future scope of herbal antifungal cream formulation using neem extract is highly



promising due to the growing global interest in herbal medicines, natural cosmetics, and plant-based therapeutic products. With increasing cases of fungal infections and the emergence of resistance against conventional antifungal drugs, there is a strong need for the development of safer, more effective, and economical alternatives. Neem-based herbal formulations possess immense potential for future pharmaceutical and dermatological applications because of their broad-spectrum antimicrobial activity, excellent therapeutic properties, and minimal side effects. Further research can focus on improving the efficacy, stability, and patient acceptability of the formulation through advanced pharmaceutical techniques and novel drug delivery systems.

### 10.1 Future Research Opportunities

In future studies, the antifungal activity of neem extract can be evaluated against a wider range of fungal species using advanced microbiological techniques and clinical investigations. Additional in-vitro and in-vivo studies may be conducted to determine the exact mechanism of action of the active phytoconstituents present in neem. Research can also be extended toward the isolation and purification of specific bioactive compounds responsible for antifungal activity, which may help in developing more potent herbal antifungal agents. Standardization of herbal extracts and quality control parameters will further improve the reproducibility, safety, and effectiveness of herbal formulations.

Future formulation approaches may include the incorporation of neem extract into nanoemulsions, liposomes, hydrogels, microspheres, and other novel topical drug delivery systems to enhance skin penetration and therapeutic performance. Such advanced delivery techniques can improve drug release, increase bioavailability, and prolong the antifungal action of the formulation. Combination therapy using neem extract along

with other medicinal plant extracts such as tulsi, turmeric, aloe vera, tea tree oil, or clove oil may also be explored to obtain synergistic antifungal and anti-inflammatory effects. These polyherbal formulations may provide enhanced therapeutic benefits and broader antimicrobial activity.

Large-scale industrial production and commercialization of herbal antifungal creams also represent an important future opportunity. Since neem is widely available and relatively inexpensive, the formulation can be manufactured economically for rural and urban healthcare markets. Herbal pharmaceutical companies and cosmetic industries can develop neem-based dermatological products targeted toward consumers seeking natural and chemical-free alternatives. Further clinical trials and regulatory approvals may facilitate the introduction of standardized herbal antifungal creams into mainstream healthcare systems.

### 10.2 Clinical and Analytical Advancements

In addition, future research can evaluate the long-term safety profile, skin compatibility, and storage stability of the formulation under different environmental conditions. Toxicological studies and patient-based clinical evaluations may help establish the formulation as a reliable and scientifically validated therapeutic product. Modern analytical techniques such as High-Performance Liquid Chromatography (HPLC), Fourier Transform Infrared Spectroscopy (FTIR), and Gas Chromatography-Mass Spectrometry (GC-MS) can be utilized for detailed characterization of the phytochemical constituents of neem extract. The growing preference for herbal medicines across the world provides a strong platform for the expansion of research in this field. Herbal formulations based on neem can contribute significantly to the development of sustainable healthcare products that are safer, environmentally friendly, and economically feasible. Therefore, the



herbal antifungal cream formulated using neem extract has substantial future scope in pharmaceutical research, cosmetic applications, dermatological therapy, and commercial herbal product development.

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