



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Research Article

Formulation And Evaluation of Herbal Essential Oil-Based Nail Lacquer for Management of Onychomycosis

Anjali Bawaskar*, Vishal Keshewar, Pallavi Korde, Komal Pathade, Dr. Shivashankar Mhaske, Vinod Chaware, Shraddha Saubhage

Satyajeet College of Pharmacy, Mehkar (M S) India.

ARTICLE INFO

Published: 24 May 2025

Keywords:

Onychomycosis, Nail lacquer, Cinnamon oil, *Mimosa pudica*, Antifungal, Herbal formulation, Essential oils, Nail drug delivery, Nitrocellulose, Shellac, HPMC, Natural preservatives

DOI:

10.5281/zenodo.15504772

ABSTRACT

Onychomycosis, a fungal infection of the nails, presents a persistent therapeutic challenge due to poor drug permeability through the nail plate and frequent recurrences. This study focuses on the formulation and evaluation of an herbal nail lacquer incorporating Cinnamon oil, known for its potent antifungal properties, and *Mimosa pudica* extract, recognized for its wound healing and antimicrobial activities. The formulation employs shellac or nitrocellulose as film-forming agents, castor oil for nail conditioning, ethanol (90%) and propylene glycol as solvents and permeation enhancers, and HPMC for viscosity modulation. Sodium benzoate acts as a preservative, while purified water ensures appropriate consistency. The nail lacquer was evaluated for its physicochemical properties, drying time, film formation, adhesion, viscosity, and antifungal efficacy against common dermatophytes. Results indicated a stable formulation with satisfactory film-forming ability, good adherence, rapid drying time, and significant antifungal activity, demonstrating its potential as an effective topical treatment for onychomycosis. Further in vivo studies are recommended to validate clinical efficacy and safety.

INTRODUCTION

Over the last decades, the treatment of illness has been fulfilled by delivering medicines to the mortal body via colourful routes: oral, maternal, topical, inhalation, etc. Every medical condition demands an accurate and applicable treatment. Infect, the study of resolving the case's complaint

with the least detriment done to the case's health is said to be the introductory thing of any remedy. Further over a good treatment fashion necessitates thorough knowledge of pharmacokinetics and pharmacodynamics of the intended medicine. (1) Onychomycosis is defined as a habitual form of fungal nail infection that appears in either toe or

***Corresponding Author:** Anjali Bawaskar

Address: Satyajeet College of Pharmacy, Mehkar (M S) India.

Email ✉: anjaliBawaskar7@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



cutlet region of the mortal body. The Greek words "onyx"(nail) and "mikes"(fungus) are combined to form the word "onychomycosis". Onychomycosis falls under the order of the most current form of the complaint around the world. Onychomycosis is a fungal infection that affects toenails or fingernails and may involve any element of the nail unit. It involves the entire nail anatomical region similar to the plate, bed, and matrix corridor. The symptoms of onychomycosis include nail thickening, nail splitting, nail face roughening, nail abrasion, irregular face changes on a nail as well as the girding region, and nail plate detachment from the rest of the nail factors. Numerous allopathic modalities are available for the treatment of onychomycosis, but they bear a prolonged course of treatment and constantly have serious side-effects (systemic and topical antifungal drug or a combination of topical and systemic remedy, debriding to the healthy nail. It has an impact on about 20% of the global population. Onychomycosis is more common in diabetes cases than in nondiabetic cases. Due to pressure, the case's diseased nail's large, sharp edges erode the nail bed and infect the near skin towel. Mortal nails can be used for further than just protection and decoration; still, employed as another route for medicine release, particularly in nail infections like onychomycosis. (2) Long-term methodical surgery can affect in major adverse effects and liver damage, and due to limited blood rotation, only a nanosecond medicine portion can attain a target.

As a result, topical treatment is constantly regarded as a feasible volition. These nail conditions are extensively spread in the population, particularly among senior and vulnerable-compromised cases. Essential canvases, with their antifungal parcels, present a promising vision for the operation of onychomycosis. Onychomycosis, also known as Tinea unguium, is a fungal infection of the nail. Onychomycosis is a contagious impurity of fingernails and toenails that influences around the world population. This infection occurs substantially in diabetic and aged cases. The most common cause is dermatophytes, non-dermatophytes, Molds, and incentive substantially Africans. About 80% cases of onychomycosis are affected. Onychomycosis is a lot more common in polygenic complaint cases than in non-diabetic cases. The case's unhealthy nail has broad, sharp edges that infect the encompassing skin towel, inflicting corrosion of the nail bed. (8,9,10,11)

❖ **Common symptoms of onychomycosis include:**

- White or yellow nail.
- Discoloured
- Separated from the nail bed
- Smell

1.1 Structure of The Human Nail.



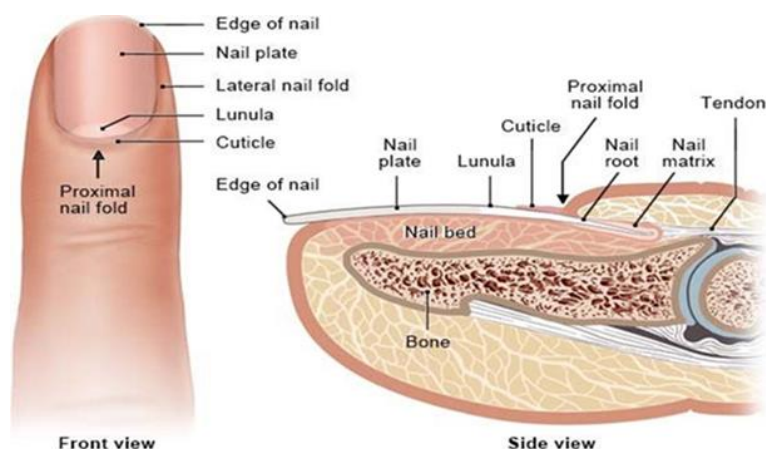


Fig.no 1. Structure of human nail (12)

The human nail consists of following parts.

- Nail matrix or the root of the nail
- Nail bed
- Eponychium or cuticle
- Paronychium
- Hyponychium
- Nail plate
- Lunula (13)

▪ **Nail Root:**

The root of the fingernail is also known as the germinal matrix. This portion of the nail is actually beneath the skin behind the fingernail and extends several millimetres into the cutlet. The fingernail root produces the maximum of the volume of the nail and the nail bed. This portion of the nail doesn't have any melanocytes, or melanin producing cells. The edge of the germinal matrix is seen as a white, crescent structured structure called the LUNULA

▪ **Nail Bed:**

The nail bed is part of the nail matrix called the sterile matrix. It extends from the edge of the

germinal matrix (Lunula) to the hyponychium. It is a thin, soft, no cornified epithelium, connected with the frontal subcaste of the nail plate and underpinning papillary dermis and contains the blood vessels, jitters, and melanocytes, or melanin-producing cells. As the nail is produced by the root, it streams down along the nail bed, which adds material to the bottom of the nail making it thicker. The nail bed is made up of thin, soft epithelium that extends the whole length beneath the nail. It acts as a holder for the nail plate.

▪ **Cuticle / Eponychium:**

The cuticle of the fingernail is also called the eponychium. The cuticle is positioned between the skin of the cutlet and the nail plate, fusing these structures together and furnishing a leakproof hedge.

• **Perionychium:**

The perionychium is the skin that overlies the nail plate on its sides. It is also known as the parochial edge. The perionychium is the point of hangnails, ingrown nails, and an infection of the skin called parochial. It is also called the side nail fold, which helps in keeping dirt and bacteria down from the nail. It is the soft towel that surrounds both

fingernails and toenails. It is responsible for the stability of the nail Because of its consistence and compact design; the nail's morphology acts as a hedge to the entry of topically applied substances. Medicines can percolate more fluently through nails by dismembering the disulfide bonds in keratin

- **Hyponychium:**

The hyponychium is the area between the nail plate and the fingertip. It's the junction between the free edge of the nail and the skin of the fingertip, also providing a waterproof barrier.

- **Lunula:**

The edge of the germinal matrix is seen as a white, crescent shaped structure called the LUNULA. (14)

Function of nail:

1. Protect the soft tissues of the fingers and toes from injury.
2. Enhance sensation.
3. Used for cutting and scraping.
4. Support the tips of fingers and toes
5. Precise movement of finger tips (15)

1.2 Anatomy of Human Nail

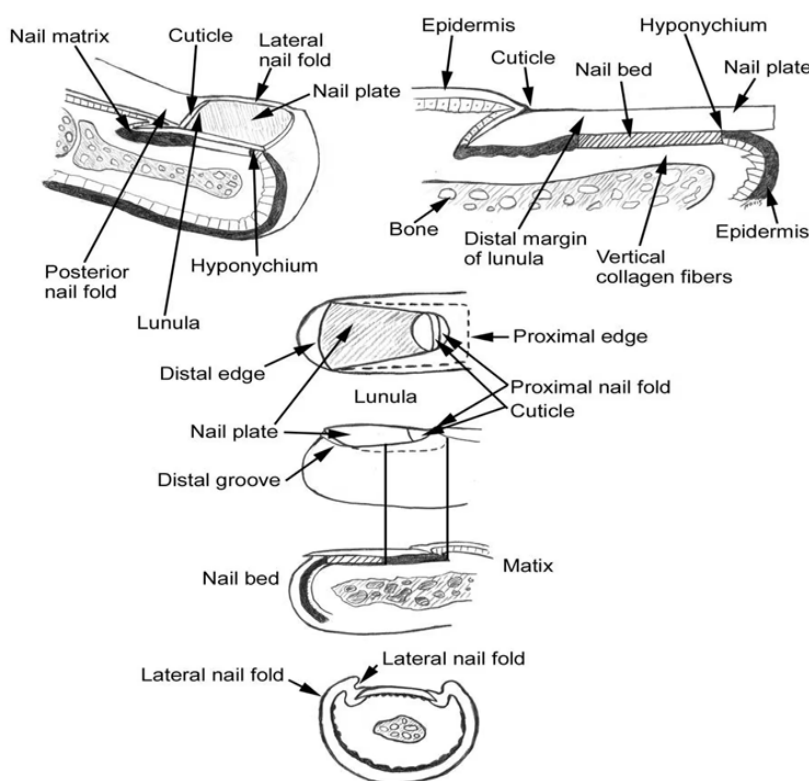


Fig.no 2. Anatomy of human nail

The chemical composition of the mortal nail oppressively differs from other body membranes. The plate, composed of keratin motes with numerous disulfide liaison and low lipid

situations, it tends more like a hydrogel than basophilic membrane.

The human nail plate consists of three layers:

- Dorsal layer {derived from the matrix}
- Ventral layer {ventral layer derived from nail bed}
- Intermediate layer {the intermediate layer is three - quarter of the whole nail thickness & consists of the soft keratin}
- The dorsal layer of the nail is thin, made of hard keratin rich in sulphur (mainly cysteine), which makes up 94% of the nail's weight. This layer diffuses into the nail plate. The ventral layer, soft hyponychial tissue, is prone to pathological changes, making effective drug concentration crucial for treating nail diseases

Nail Growth:

Nail growth is fastest in childhood and slows with age, growing forward due to pressure from the posterior nail fold. Growth can be affected by nail fold issues or abnormal keratinization, leading to thickening, ridges, pits, discoloration, brittleness, splitting, or onycholysis. Severe illness can cause transverse grooves, and white spots, seen in 62% of people, result from imperfect keratinization and retained nuclear material.

1.3 Nail Diseases:

The nail plate may appear abnormal as a result of, a natural disfigurement, complaint of skin with involvement of the nail bed, methodical complaint, reduction of blood force, original trauma, tumours of the nail fold or nail bed, infection of the nail fold, infection of the nail plate conditions of the nails vary from saturation or abrasion to painful and enervating countries leading to atrophy, inflammation and brittle split nails.

Onychomycosis:

The Greek terms onyx, which means nail, and mykes, which means fungus, are where the word onychomycosis originates. Onychomycosis, a common fungal infection of the nails, affects millions worldwide, causing discoloured, thickened, and brittle nails. It's an infection of the nail due to fungi that include dermatophytes, on-dermatophyte Molds, and incentive (Candida species). These dermatophyte infections, substantially caused by *Trichophyton rubrum* and *Candida* species, are observed in over 90 of cases. Infected nails are thick and discoloured, which leads to both physical pain and cerebral stress (4). Onychomycosis is a fungal infection of the nail unit. When dermatophytes beget onychomycosis, this condition is called tinea unicum. The term onychomycosis encompasses the dermatophytes, provocations, and saprophytic earth infections. An abnormal nail not caused by a fungal infection is a dystrophic nail. onychomycosis can infect both fingernails and toenails, but onychomycosis of the toenail is much more current. bandied in detail in the ensuing sections are all evolving angles of the content, including complaint burden, clinical types, staging, opinion, and operation of toenail onychomycosis. (17)



Fig.no 3. Structure of onychomycosis

Classification of onychomycosis:

- a) Distal Subungual Onychomycosis
- b) White Superficial Onychomycosis

- c) Proximal Subungual Onychomycosis
- d) Candidal Onychomycosis
- e) Total Dystrophic Onychomycosis (18,19)

1.4 Etiology of Onychomycosis

The causative pathogens of onychomycosis include dermatophytes, candida and non-dermatophytes (5) Molds In temperate western regions, dermatophytes are the primary fungi causing onychomycosis, whereas in hot and sticky tropical and tropical climates, Candida and non-dermatophytes Molds are more generally responsible. (20)

Dermatophytes Trichophyton rubrum the most common dermatophyte involved in onychomycosis. Other dermatophytes that may be involved

- Trichophyton interdigital
- Epidermophyton floccosum

- Trichophyton violaceum
- Microsporum gypseum
- Trichophyton tonsurans
- Trichophyton soudanense

Other Pathogens:

Candida:

- substantially causes fingernail onychomycosis.
- Common in individuals whose hands are constantly submerged in water.

Non-dermatophytes Molds:

- Scytalidium (lately renamed Neoscytalidium)
- Scopulariopsis
- Scytalidium primarily affects people in tropical regions but can persist in temperate climates if they move latterly.

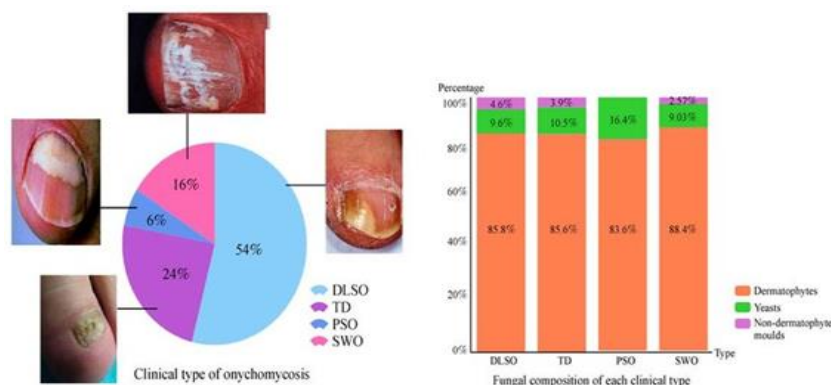


Fig.no 4. Clinical type and fungal Etiology of onychomycosis in China

Risk Factors for Onychomycosis:

- Family history of onychomycosis
- Increasing age
- Poor health conditions
- Prior trauma to nails
- Warm climate exposure
- Participation in fitness activities
- Immunosuppression (e.g., HIV, drug-induced)

- Communal bathing
- Occlusive footwear

Diagnosis of Onychomycosis:

Fifty percent of all nail dystrophy are fungal in origin; it is not always possible to identify similar cases directly. Treatment period of the nail is substantially long- term and it takes time for the nail to grow fully before the treatment can be rendered as successful. Laboratory opinion consists of microscopy to fantasize fungal rudiments in the nail sample and culture to identify the species concerned. (21)

Treatment:

Various oral and topical therapies have been used in the past to treat onychomycosis. Commonly used treatments for onychomycosis: (5)

1. Topical Antifungal Agents
2. Nail removal, avulsion (6)
3. Oral therapy
4. Lasers
5. Photodynamic Therapy Miscellaneous

• Prevention:

- ✓ Fungal nail infections can be prevented by the following methods-
- ✓ Avoiding injury to nails, which may increase the threat of developing a nail infection.
- ✓ Wearing footwear similar as flip- duds in public places, similar as collaborative bathing shower places, locker apartments, etc.
- ✓ Avoid kerchief (towel)sharing.
- ✓ Replacing old footwear, as it might be contaminated with fungal spores (22)

1.5 Herbal Nail Lacquer

Herbal nail lacquer is a type of nail polish formulated with natural, factory- grounded constituents. Unlike conventional nail lacquers, which frequently contain synthetic chemicals and potentially dangerous substances, herbal nail lacquers prioritize the use of herbal excerpts, essential canvases, and other natural composites. These products aim to offer both aesthetic and health benefits while minimizing environmental impact and chemical exposure. Topical nail medications like lacquers, varnishes, enamels etc. are generally used to enhance beauty of nails, conducting colour and lustre to nail. But in recent times treated lacquers are especially designed for the nail. These medications are generally used in fungal conditions. Use of this system avoids oral toxin anti-fungal medicines. Medicated nail lacquers are the phrasings that have minimal antifungal efficacy as a trans ungual medicine delivery system. After operation, the detergent from the lacquer expression evaporates leaving an occlusive film on which the medicine attention is advanced than in the original expression. This increases the prolivity grade and saturation through thick keratinized nail plate.

Advantages

- It cannot be fluently removed by rubbing or washing.
- In addition, the effect is long lasting; single operation of lacquer provides protection for one week.
- Preparation is easy as compared to oral lozenge form.
- minimum or no systemic side effects.

Disadvantages



- Rashes relate to adverse effects similar as periungual erythema and erythema of the proximal
 - nail fold was reported most constantly.
 - Other adverse effects which were allowed to be casually related include nail complaint similar as shape change, irritation, ingrown toe nail and abrasion or discoloration
- ✓ It should have sufficient flexibility so that it does not crack or become brittle.
 - ✓ It should have sufficient hard surface which is resistant to impact and scratch.
 - ✓ It should have reasonable drying time (1-2 minutes) without developing bloom.
 - ✓ It should be able to maintain the above-mentioned properties for a reasonable time (about 1 week). (24)

❖ **Ideal properties of model nail lacquer:**

- ✓ It should be harmless to skin and nails.
- ✓ It should be convenient and easy to apply.
- ✓ It should be stable on storage
- ✓ It should form a satisfactory film on nails.
- ✓ It should have good wetting and flow properties so that the film formed is even.
- ✓ It should have uniform colour.
- ✓ It should have good gloss.
- ✓ It should have good adhesive properties.

❖ **Marketed Nail Lacquer Formulation.**

In 1992, first treated nail makeup was introduced named as Loceryl ®, which was formulated by the use of amorolfine 5 as medicine including with other constituents like ethanol, Eudragit RL 100, ethyl acetate, glycol triacetate. In 1999, FDA accepted Penlac ®. Appearance of this nail lacquer was set up clear and colourless liquid. It was formulated using ciclopirox 8 with butylamines of maleic acid, ethyl acetate. Table 2 summarises a variety of nail lacquer grounded retailed expression

Table no. 1 Marketed nail lacquers

Name of product	Name of drug	Indication	manufacturer
Loceryl	Amorolfine 5%	Onychomycosis	Roche laboratories, Australia
Penlac	Ciclopiroxamine 8%	Onychomycosis	Dermil laboratories, Canada
Loprox	Ciclopirox	Onychomycosis	Avents pharma Ltd, Mumbai, India.
Econail	Econazole 5%	Onychomycosis	JSJ Pharmaceutical, Chaleston

2. AIM AND OBJECTIVES

Aim:

- The aim of the study is to design and development of herbal nail lacquer for the treatment of onychomycosis
- To develop and evaluate an herbal essential oil-based nail lacquer incorporating cinnamon



oil and Mimosa pudica plant extract, aiming to assess its efficacy, safety, and potential as an alternative therapeutic option for the management of onychomycosis.

- This study focuses on the formulation process, stability, antimicrobial activity, and overall performance of the nail lacquer in combating fungal infections of the nails.
- The topical formulations conventionally used in dermatology i.e. creams, lotions, powders, gels, oils, etc. are not specifically adapted to the nail since they are readily removed by rubbing, wiping, and washing but the film of nail lacquer remains in contact with the nail for longer period of time.
- The drugs which are available in the market are too expensive and some people cannot afford to buy them. Hence, it is necessary to find an alternative method for the treatment of fungal infections.
- Herbs having antifungal activity can be used in the preparation of nail lacquer so that the product will not be having any side effects.
- Nail lacquers containing drug are herbal and have been termed trans ungual delivery system for treatment of nail diseases onychomycosis.
- These formulations are essentially made from cinnamon essential oil and extract of mimosa pudica for the providing antifungal activity
- These formulations are also made of organic solutions of a film-forming polymer and contain the drug to be delivered. When they are applied to the nail plate, the solvent evaporates and leaves a

polymer film containing drug onto the nail plate.

- The drug is then slowly released from the film and penetrates into the nail plate and the nail bed.
- The drug concentration in the film is much higher than concentration in the original nail lacquer as the solvent evaporates and a film is formed on the nail plate.
- In addition, lacquers containing drug must be colourless and non-glossy to be acceptable to male patients

OBJECTIVES

- To develop an herbal essential oil-based nail lacquer using cinnamon oil and Mimosa pudica plant extract.
- To formulate a nail lacquer using herbal essential oils with antifungal properties suitable for the management of onychomycosis.
- To select and optimize the concentration of various herbal essential oils (such as cinnamon oil) for maximum antifungal efficacy.
- To evaluate the physicochemical properties of the formulated nail lacquer, including viscosity, pH, spread ability, and drying time. Etc
- To assess the antifungal activity of the nail lacquer using in vitro methods against common fungal pathogens responsible for onychomycosis (e.g., *Trichophyton rubrum*, *Candida albicans*).
- To determine the stability of the nail lacquer under various storage conditions over a specified period.



- To conduct a sensory evaluation for factors like texture, odour, ease of application, and patient acceptability.
- To perform a clinical evaluation (if applicable) to assess the efficacy, safety, and tolerability of the herbal nail lacquer in patients with onychomycosis.
- To compare the effectiveness of the herbal essential oil-based nail lacquer with conventional antifungal treatments.
- To study the potential adverse effects or allergic reactions associated with the herbal formulation

3.1. Drug profile

- **Herbal essential oil**

Cinnamon oil:



Fig .no 4 Cinnamon oil

3. DRUG AND EXCIPIENTS PROFILE.

Table no. 2 Scientific Classification of cinnamon

Category	Classification
Kingdom	Plantae
Division	Magnoliophyte (angiosperms)
Class	Magnoliopsida (dicotyledons)
Order	Laureles
Family	Lauraceae
Genus	Cinnamomum
Species	c. verum or c. zeylanicum
Common name	Cinnamon / dalchini

- Synonym Cinnamomum verum, Cinnamomum zeylanicum, Cinnamomum cassia, Dalchini, sweet wood
- Parts used for extraction bark, leaves, roots, twigs bark and leaves both exhibit strong antifungal activity (6)
- Chemical constituents: bark can contain cinnamaldehyde, leaves contain eugenol, bark and leaves linalool, cinnamic acid in bark, camphor in root/bark
- Bark having the strong antifungal, antimicrobial, antioxidant activity. and other parts like leaves, roots have analgesic, antiseptic, activities
- Method of extraction are used steam distillation, hydro distillation, solvent extraction etc.
- Primarily extracted from the bark and leaves of cinnamon it contains cinnamaldehyde, eugenol, linalool, cinnamic acid, coumarin
- Cinnamon oil has demonstrated significant antifungal activity against candida species studies have shown that cinnamon oil effectively inhibits the growth of candida

albicans, c. parapsilosis and c. Ortho psilosis.
(7)

- At range from 0.039% to 0.078%(v/v) fungicidal activity observed. And it also acts against aspergillus flavus and Rhizopus nigricans.
- To analyse the cost-effectiveness and feasibility of large-scale production of the herbal nail lacquer.

Mimosa pudica:



Fig. no 5 mimosa pudica plant

Herbs with Antifungal Activity:

Table. 3 Scientific Classification of mimosa pudica. (27)

Category	Classification
Kingdom	Plantae
Division	Magnoliophyte
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae/Mimosaceae
Sub – Family	Mimosoideae
Genus	Mimosa
Species	Pudica

- Synonym: Laajvanti, touch me not, and Chhui-mui, and Mimosa pudica L., also called sensitive plant or touch-me-not.
- *Mimosa pudica*, belonging to the genus *Mimosa* (Family: Mimosaceae), commonly grows as a weed throughout Vietnam.
- Traditionally, *M. pudica* has been used to treat various ailments such as diarrhoea, insomnia, tumours, headaches, skin conditions, fever, and high blood pressure.
- Scientific studies have identified several bioactive compounds in the plant, including tannins, steroids, flavonoids, glycosides, mimosine (a non-protein amino acid), and alkaloids (25)
- Parts Used: Leaves, barks, flowers, fruits and roots. Leaves and roots Provide more antifungal activity.
- Chemical Constituents: leaves of *Mimosa pudica* contains alkaloid known as ‘mimosine’. Roots of *Mimosa pudica* contains tannins, mimosine, calcium oxalate crystals and ash.
- The leaves of *M. pudica* contain alkaloid mimosine. Root contains tannins, ash, calcium oxalate crystals and mimosine. “It is susceptible to several herbicides, including dicamba, glyphosate, picloram and triclopyr”
- Method of Extraction: Maceration for 24 hours using ethanol, water or methanol.
- Quantity Required for Antifungal Activity: 40mg/ml. (28)

- Mimosa pudica, also known as the sensitive or humble plant, belongs to the Fabaceae family.
- It is a prostrate or semi-erect subshrub found in tropical America, Australia, and India.
- The plant grows up to 30 cm tall, with cylindrical stems (up to 2.5 cm in diameter), and leaves 0.6–1.2 cm long and 0.3–0.4 cm broad.
- Seeds are pale brown, compressed, oval-elliptic, about 2.5 mm long and 0.3 cm wide.
- Notable for its touch-sensitive folding leaves, M. pudica has been used traditionally to treat alopecia, diarrhoea, dysentery, insomnia, and urogenital infections.
- It shows pharmacological activities like antibacterial, antifungal, antivenom, antifertility, anticonvulsant, antidepressant, aphrodisiac, and wound-healing effects.
- Phytochemical screening reveals the presence of bioactive compounds such as terpenoids, flavonoids, glycosides, alkaloids, tannins, and antioxidants, which have therapeutic potential with fewer side effects. (26)
- Touch me not plant is a prickly herb. The extract of the leaves has been used for ages to balance the blood glucose levels, heal cuts and wounds. The leaf extract has anti-inflammatory, anti-oxidant, and anti-aging properties that make it suitable for treating skin conditions. The grinded leaf paste is used to treat eczema. (33)

3.2. Excipient profile:

1. Film-Forming agent

Film forming agents Film forming agent- Nail polish is applied the detergent evaporates,

leaving the polymer to form a film on the nail. One pivotal step in creating a suitable nail lacquer type is choosing a film-forming agent. Includes nitrocellulose, cellulose acetate, cellulose acetate butylate, and ethyl cellulose. (29)

- **Shellac or hydroxypropyl cellulose/nitrocellulose** part of the (Shellac or hydroxypropyl cellulose) is to form the defensive film over the nail it's suitable for the herbal nail lacquer. it's natural and safe extensively used in herbal expression

2. Plasticizer

Plasticizers The plasticizing agent plays a significant part in making an invariant film of nail lacquer on the nail. still, the addition of a plasticizer improves the buff and cohesion of the film. An essential element in the medication of nail polish to increase the nail lacquer's malleability and reduce its propensity to shrink so that a homogeneous film forms. For illustration dibutyl phthalate and castor oil painting Nail polish stays flexible, it'll be dries, making the nail polish last longer. (29, 30)

- **Triethyl citrate or castor oil**

painting part of plasticizer Triethyl citrate or castor oil painting is to increase inflexibility of the film it's biocompatible, supports, essential oil painting solubility. (34)

3. Solvent

Solvents are volatile organic liquids that mix all of the elements in lacquer composition to create a homogeneous viscous preparation. Volatile organic liquids are widely employed as solvents in nail lacquer to dissolve all of the ingredients and produce a smooth, homogenous solution. These solvents must evaporate at a steady but not excessive rate in order to generate a hard,



continuous, and impermeable covering. To obtain the appropriate evaporation rate, a combination of solvents is usually used rather than a single one. (31) Low boiling point solvents include ethyl ether, acetone, and ethyl alcohol. Solvents with a medium boiling point include N-butyl acetate and n-butyl alcohol, among others. High boiling point solvents, such as ethyl lactate. Alcohols, notably ethyl, isopropyl, and butyl, are effective diluents.

▪ **Ethyl acetate:**

Role of solvent is to solubilizes oils and helps film dry quickly it has safe and evaporates easily, commonly used in herbal lacquers. (34)

4. Penetration enhancer

Propylene glycol or urea:

The role of penetration enhancer is to enable active substances pass through the nail plate. Propylene glycol or urea are mildly beneficial and can be utilized in natural topical products, while the addition of penetration enhancers to nail lacquer can boost drug permeability and, ultimately, therapy efficacy. (32)

5. Viscosity enhancer

Xanthan gum or HPMC:

Viscosity enhancer can Improves texture and spreading of nail lacquers. It is a natural and safe with plant extract of mimosa pudica.

6. Preservative (optional)

Sodium benzoate or potassium sorbate:

Preservative can be helps to prevents a microbial growth it is commonly used in herbal or cosmetic products

4. MATERIAL AND METHOD

4.1 Plant Material

Mimosa pudica: Leaves and roots provide more antifungal activity. Extracted by Soxhlation for 24 hours using ethanol, water or methanol. (35) The dried Mimosa pudica plant were collected from the local market in mehkhar and authenticated by Professor Zameer shah, and professor shatrughna nagrik, Satyajeet collage of pharmacy mehkhar buldhana

4.2 Ethanolic extraction of mimosa pudica.

Materials required:

- ✓ Dried mimosa pudica plant (whole plant or specific part like leaves)
- ✓ Ethanol (70-90%)
- ✓ Clean glass container with lid
- ✓ Muslin cloth or Whatman filter paper
- ✓ Rotatory evaporator or water bath
- ✓ Weighing balance
- ✓ Grinder or mortar pestle

Extraction Procedure

- The leaves were thoroughly cleaned under running tap water before being rinsed in distilled water.
- The leaves were dried in a shady area for two weeks before being processed into a powder using an electric grinder. (35)
- For two days, 50gm of powder was macerated in a conical flask with 250ml of ethanol, shaking 2randomly.
- The extract was filtered using Whatman no. 1 filter paper, and the filtrates were collected for



solvent evaporation to produce mimosa pudica extract.

➤ The extract was evaporated until fully dry.

➤ The yield of the obtained residue was reported for future use.

➤ The extract percentage was calculated by dividing the medication weight by the original plant powder weight. (36)

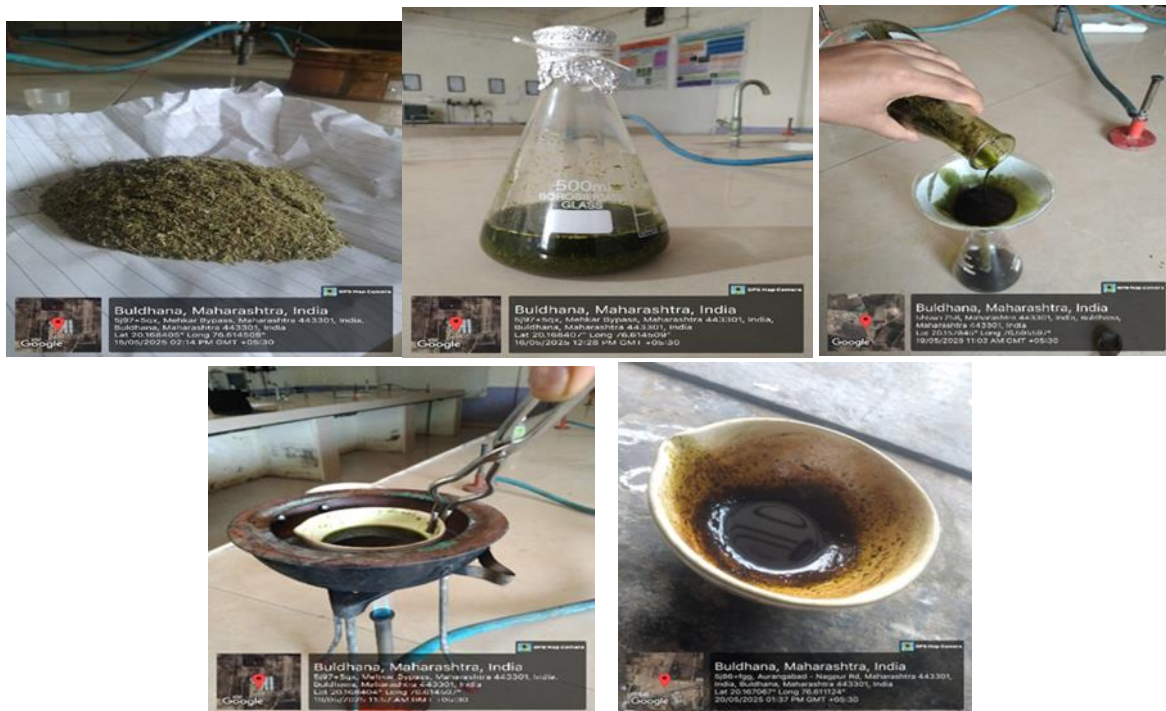


Fig.no extraction of mimosa pudica

Percentage yield = $\frac{\text{extracted weight (g)}}{\text{Weight of the powdered taken (g)}} \times 100\%$

Formulation of nail lacquer

Weight of the powdered taken (g)

Ingredients:

4.3 Experimental Work:

Table no.3 composition of nail lacquer

Ingredients	Function	Quantity (% w/v)
Cinnamon oil	Antifungal agent	5%
Mimosa pudica extract	Herbal antifungal agent	5%
Shellac/ nitrocellulose	Film-forming agent	10%
Castor oil	Plasticizer & carrier	2%
Ethanol (90%)	Solvent & drying agent	70%
Propylene glycol	Penetration enhancer	3%
HPMC (hydroxypropyl methylcellulose)	Viscosity enhancer	2%
Sodium benzoate	Natural preservative	0.2%
Purified water	Vehicle	Volume up to 100 ml

Table no 4 composition for 20 ml nail lacquer

Sr.no	Ingredient	F1	F2	Function
1	Cinnamon oil	1.0 ml	----	Antifungal agent
2	Mimosa pudica extract	-----	1.0 ml	Herbal antifungal agent
3	Shellac/nitrocellulose	2.0 g	2.0 g	Film-forming agent
4	Castor oil	0.4 ml	0.4 ml	Plasticizer & carrier
5	Ethanol	14.0ml	----	Solvent & drying agent
6	Ethyl acetate	----	14.0ml	Solvent & drying agent
7	Propylene glycol	0.6 ml	0.6 ml	Penetration enhancer
8	HPMC (hydroxypropyl methylcellulose)	0.4 g	0.4 g	Viscosity enhancer
9	Sodium benzoate	0.04 g	0.04 g	Natural preservative
10	Purified water	Up to 20ml	Up to 20 ml	Vehicle

Formulation procedure:

- Triturate the film former (nitro cellulose) to make powder of it
- Dissolve nitrocellulose in ethanol using a magnetic stirrer until a clear solution is formed.
- Add castor oil, propylene glycol, and HPMC slowly with continuous stirring.
- Add cinnamon oil and mimosa pudica extract, mix well.
- Add sodium benzoate and make up the volume with purified water.
- Filter with filter paper and transfer all content in to suitable container, label it and submit (34)



[F1]



[F2]

Fig.no.7 formulation of nail lacquer**5. EVALUATION TESTS****5.1 Evaluation of nail lacquer:****1. Organoleptic evaluation:**

The formulations were visually examined for their appearance, including colour, application quality, and transparency. Organoleptic characteristics were assessed using several physical parameters such as colour, Odor, and appearance. (37) Visual observations were conducted of the nail lacquers'

colour, transparency, and application quality. The viscous liquid [F1] has appearance like the yellow tone Translucent shiny liquid and [F2] are Dark brown tone Translucent amber or light honey brown liquid

2. Smoothness of Flow and Gloss:

- **Flow:**

This is the character of the film. The films are placed to the surface of the nail paint, and after drying, rub the nail surface to examine the smoothness of the nail paint. Each formulation's nail lacquer was put into a separate glass plate from a height of 1.5 inches, spread out, and allowed to rise vertically before being conspicuously checked for film smoothness (37) The sample was put into a glass plate and spread on a glass plate, causing it to rise vertically and visually examined for smoothness of film.

- **Gloss:**

The shine appeared once the nail lacquer mixture was applied to the nail. 37 A sample of nail lacquer was put over the nail, and the gloss was visible. The sample formed a uniform layer on the nail. The gloss and the commercially available cosmetic nail lacquer were visually contrasted. (39) Overall, the flow's smoothness was assessed by contrasting it with nail lacquer that is sold. Glossiness was graded as good (++), very good (+++), and excellent (++++ based on visual inspection.

3. Viscosity:

A viscometer can be used to determine the viscosity of nail lacquer. The viscosity was obtained using a Brookfield viscometer. (37) The sample formed a uniform layer on the nail. The gloss and the commercially available cosmetic nail lacquer were visually contrasted. (39)

4. Drying time:

Apply the nail paint to the nail. Determine the drying period of the nail paint by exposing it to air. The optimum drying time was obtained. A sanitary, translucent surface is coated with a thin coating of lacquer that is spread or flowed out for inspection. A timer is used to estimate the drying time, which is checked by touching a fingertip to the film while no marks are evident. Inspect the films with your fingertips. At the same time, the films should be dry on contact. The term "dry-to-touch" refers to the films' ability to be touched with a fingertip without transferring any material to the finger. (37) A glass petri dish measuring 4 x 4.5 cm² was designated, and a nail lacquer formulation and commercial product were applied to it with a brush. A stopwatch was used to record the amount of time it took for the film to dry. Three copies of the readings were taken (34).

5. Hardness:

This is the measure of the film's toughness. After applying nail paint to a surface, apply pressure to test its hardness. This is the measure of the hardness of the film. Nail paint applies on surface then check the hardness of the nail paint by applying the pressure by hand and determine the hardness of nail paint.

6. Colour:

To compare colours, apply master colour standards to thumbnails and hold them side by side. Move the thumb with the standard to the right and then left. There was found the viscous liquid [F1] has appearance like the yellow tone Translucent shiny liquid and [F2] are Dark brown tone Translucent amber or light honey brown liquid

7. Spreadibility:



Spreadability of nail paint checked by applying of nail paint on nail by the nail paint brush evenly spread on nail

8. Stability:

The stability of nail lacquers must be thoroughly investigated. This can be achieved by an accelerated stability test.

9. Lacquer film thickness:

One ml of formulation was evenly distributed with an applicator brush on an 8 cm diameter Petri dish and allowed to dry at room temperature. After curing, the nail polish film was removed from the petri dish. The film thickness was measured at three distinct locations with a micrometre screw gauge, and the average was calculated.

10. Water resistance test:

This test was carried out to determine the resistance of nail lacquer against water permeability of film. The Petri dish was coated with a continuous sheet, which was then dried before being immersed in water. The weight of a Petri dish was measured before and after immersion, and the increase in weight was determined. 4.8.7. Drug Content Estimation The drug concentration of formulations was evaluated by dissolving 1 mL of nail lacquer in 10 mL of methanol. After preparing dilutions, the absorbance was measured using a UV-visible spectrophotometer at 384 nm. It was carried out to determine the water-permeability resistance. A continuous coating was placed to the petri dish and allowed to dry before being submerged in water. The weight of the petri dish was measured before and after immersion to calculate the weight growth.

It was calculated by using formulae (37)

Water resistance = $\frac{\text{Loss of the weight of lacquer}}{\text{Actual weight}} \times 100$

Actual weight

11. Non-volatile content

10 ml of sample was taken in a petri dish and initial weights were recorded. The dish was placed in the oven at 105°C for 1hr, the petri dish was removed, cooled and weighed. The difference in weights was recorded. Average of triplicate readings was noted. (40)

5.2 Determination of antifungal activity

Trichophyton rubrum, *Aspergillus Niger*, and *Fusarium* were used to investigate antifungal activity using Agar well diffusion. The fungal strain was cultured on nutritional agar. A loop of culture from the slant was added to the medium and incubated at 28°C for 48-72 hours, after which 0.1 ml of culture was uniformly distributed on plates containing the relevant media. A sterile borer was used to bore wells into the surface of the medium. Sample was added to each well and incubated for 48 hours at 28°C. The zone of inhibition was measured and compared to control. Fluconazole is used as standard. (38) Antifungal Activity of the Plant Extract The crude ethanolic extract and MP-19 compound were evaluated against fungal pathogens *Aspergillus flavus* and *Trichophyton rubrum* at concentrations of 25 mg/mL, 50 mg/mL, and 100 mg/mL, respectively. The experiment was repeated three times with each extract and antibiotic. (35)

5.3 Filling the formulation-

1. Glass bottles with a brush applicator are the most conventional container which is used for the packaging of nail lacquers.
2. The capacity varies from 8ml to 18ml.



3. The applicator consists of an air-tight aluminium canister with an acrylic fibre tip or Nib which applies polish directly to nails.

Fig.no 7 Structure of container



6. RESULT AND DISCUSSION

Table no .5 result and discussion

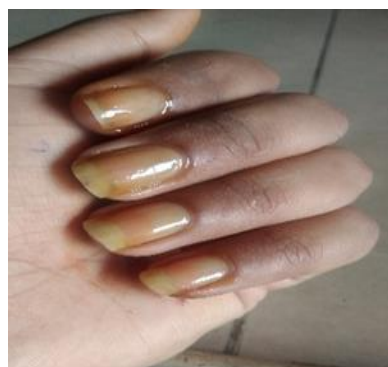
Sr no	Batches	F1	F2
1	Colour	yellow tone	Dark brown tone
2	Appearance	Translucent shiny liquid	Translucent amber or light honey brown liquid
3	Drying time (sec)	64 sec	60 sec
4	Consistency	Good	Good
5	Film thickness (mm)	0.17 mm	0.16 mm
6	Water resistant	70%	91%
7	PH	4.9	4.9
8	Hardness	Less hard	Less hard
9	Spread ability	Easily spreadable	Easily spreadable
10	Smoothness	Smooth	Smooth
11	Non- Volatile	34 ± 0.2	35 ± 0.3

Overall, the results suggest that both Nail Lacquer formulations (F1, F2) meet the desired criteria in terms of appearance, colour, consistency, pH, water resistance, hardness, spread ability, and smoothness, flow, gloss, viscosity, thickness, drying time. These findings support the potential effectiveness of the Nail Lacquer formulations as agents for treating onychomycosis. Giving an anti-fungal agent extract can give good anti-fungal activity. Further studies, including in vitro and clinical trials, would be beneficial to validate their

efficacy and safety for onychomycosis treatment. Drug delivery must be targeted for onychomycosis. Treatment for onychomycosis is challenging due to the nail plate's barrier qualities. Under the nail plate, they can prevent the entry of antifungal medications in the necessary concentration to treat fungal infections. To get the most active ingredients through the nail plate and function as an antifungal, it was necessary to choose herbal constituents and a penetration enhancer. Applying a thin layer on nail is shown as fig no.8



[F1] Appearance



[F2] Appearance

Fig.no 8 Formulation applied on nail

7. CONCLUSION

The goal of this work was to create an herbal nail lacquer with antifungal properties that would help treat onychomycosis by combining extracts from mimosa pudica and cinnamon herbal essential oil this extract loaded nail lacquer was successfully delivered through nail plate the incorporation of penetration enhancer Propylene glycol provides to enhance trans ungual delivery. Mimosa pudica extract showed good antifungal activity cinnamon oil extract considered as good choice of as antifungal agent to cure Onychomycosis. This extract loaded nail lacquer could be accepted by patient due to its natural appeal. But thus, formulation contains the other some excipients like ethanol, ethyl acetate can be produced strong odour so only these are the drawback of this formulation

8. FUTURE PROSPECTS

- Conduct rigorous antifungal activity tests.
- Enhanced the colour, odour and appearance for greater acceptance by patients and female can used as cosmetics purpose
- Nanotechnology can improve herbal active delivery, leading to increased efficacy and penetration.

- Combination Therapies: Future studies could combine herbal extracts with traditional antifungal drugs or alternative therapies to enhance effectiveness.
- Test the formulation's antifungal effectiveness in vitro and in vivo.
- Long-Term Safety and Efficacy research: As herbal nail lacquers become more clinically applicable, research in animal models may be conducted to investigate potential side effects and therapeutic durability over longer durations of use.

REFERENCES

1. Gupchup GV, Zatz JL. Structural characteristics and permeability properties of the human nail: A review. J Cosmet Sci. 1999;50:363–388.
2. Gupta AK, Simpson FC. New therapeutic options for onychomycosis. J Fungi. 2012;3(1):13–18.
<https://doi.org/10.3390/jof3010013>
3. Hay RJ, Baran R. Onychomycosis: A proposed revision of the clinical classification. J Am Acad Dermatol. 2011;65(6):1219–1227.
<https://doi.org/10.1016/j.jaad.2010.11.050>

4. Thomas J, Jacobson GA, Narkowicz CK, Peterson GM, Burnet H, Sharpe C. Toenail onychomycosis: An important global disease burden. *J Clin Pharm Ther.* 2010;35(5):497–519. <https://doi.org/10.1111/j.1365-2710.2009.01104.x>
5. Kaur R, Kashyap B, Bhalla P. Onychomycosis – Epidemiology, diagnosis and management. *Indian J Med Microbiol.* 2008;26(2):108–116. <https://doi.org/10.4103/0255-0857.40531>
6. Cohen PR, Scher RK. Topical and surgical treatment of onychomycosis. *J Am Acad Dermatol.* 1994;31(3):S74–S77.
7. Jeevanandham S, Anil AV. Formulation and evaluation of herbal antifungal nail lacquer for the treatment of onychomycosis. 2023.
8. Gaikwad PJ, Shelke DS. Polyherbal plant used in nail lacquer for treatment of fungal infection of nail. *IJARIE.* 2023;9:2684–2685. ISSN: 2395-4396.
9. Pandit AP, Kedar AA, Ranaware SV, Khandelwal KR. Antifungal nail lacquer loaded with extract of *Cissus quadrangularis* for treatment of onychomycosis. *Indian J Pharm Educ Res.* 2020;54:269.
10. Walunj SB, Kute NB, Bhand MB, Khade AB, Paimode PB. Formulation and evaluation of medicated nail lacquer of *C. quadrangularis* for treatment of onychomycosis. *J Emerg Technol Innov Res.* 2020;7(6):1482–1483. ISSN: 2349-5162.
11. Suryavanshi KA, Basru PR, Katedeshmukh RG. Review on Nail Transungual Drug Delivery System. *Am J PharmTech Res.* 2012;2(5):222–224.
12. Gaikwad PS, Pagare RV. [Institutional project – Pravara Rural Education Society's College of Pharmacy, Chincholi, Nashik]. Unpublished work.
13. Rathi AR, Popat RR, Adhao VS, Shrikhande VN. Nail lacquer delivery system: A review. *Int J Pharm Educ Nutr.* 2020;9. <https://doi.org/10.18231/j.ijpen.2020.002>
14. Jilsha G, Jose A, Thomas A, Habeeb F, Therese I, Sebastian S. Formulation and evaluation of nail polish with herbal active ingredient. *ISO 9001:2015 Certified Journal.* 2020;12:851.
15. Shirwaikar AA, Thomas TA, Lobo R, Prabhu KS. Treatment of onychomycosis: An update. *Indian J Pharm Sci.* 2008;70(6):710–714.
16. Tyagi S, N K, Kaur R, Rawat D. A study of etiology and epidemiology of onychomycosis from a tertiary care hospital in North India. *Int J Res Med Sci.* 2021;9(4):1186–1190. <https://doi.org/10.18203/2320-6012.ijrms20210442>
17. Flores AF, Lima MS, Nova AM. Histopathology of nail unit. *Rom J Morphol Embryol.* [Year not provided].
18. Yadav K, Mishra JN, Vishwakarma DK. Formulation and development of antifungal nail lacquer containing miconazole nitrate used in treatment of onychomycosis. 2019;9:737. <https://doi.org/10.29322/11sRP.9.04.2019.p8890>
19. Winston JA, Miller JL. Treatment of onychomycosis in diabetic patients. *Clin Diabetes.* 2008;26(4):170–174.
20. Elewski BE. Onychomycosis: Pathogenesis, diagnosis, and management. *Clin Microbiol Rev.* 1998;11(3):415–429.
21. Kolodchenko YV, Baetul VI. A novel method for the treatment of fungal nail disease with 1064 nm Nd:YAG. *J Laser Health Acad.* 2013;2013(1):42–47.
22. Muthukumar M, Arunpandian J, Rajeev T, Thaila R, Jayalakshmi B, Senthilraja M. New insights of transungual delivery of phytoconstituents loaded nail lacquer for therapy of nail diseases. [Journal name not provided].

23. Aswani VM. Formulation and evaluation of a medicated nail lacquer for the treatment of onychomycosis [dissertation]. Coimbatore: RVS College of Pharmaceutical Sciences; 2015.
24. Bigal HG. The sensitive plant *Mimosa pudica* [Internet]. 2010 [cited 2010 May 13];1–4. Available from: File path "C:/Documents and Settings/User/My Documents/BBC/-h2g2 the Sensitive". (Note: This reference is improperly sourced and not citable in academic work without proper URL or publication information.)
25. Le Thoa NT, Nam PC, Nhat DM. Antibacterial activities of the extracts of *Mimosa pudica* L.: An in-vitro study. *Int J Adv Sci Eng Inf Technol*. 2015;5(5):358–361.
26. Johnson K, Narasimhan G, Krishnan C. *Mimosa pudica* Linn – A shyness princess: A review of its plant movement, active constituents, uses and pharmacological activity. *Int J Pharm Sci Res*. 2014;5(12):5104–5118.
27. Ahmad H, Sehgal S, Mishra A, Gupta R. *Mimosa pudica* L. (Laajvanti): An overview. *Pharmacogn Rev*. 2012;6(12):115–119.
28. Mohite MS, Kharat J, Deshmukh S, Kashid G. Formulation and evaluation of herbal-based nail polish. *Cross Curr Int J Med Biosci*. 2022;4(2):20–28.
29. Gama JA, Luo Q, van der Gronde T. [Full reference information needed – authors and titles are not sufficient to create complete citations.]
30. Chandra P, Das M, Grigoleit HG, Grigoleit P, Jeong H, Kabbani N, Kalapos MP, Ruzsányi V, Sasanami T. [Full reference details needed – incomplete for Vancouver style.]
31. Cutrín-Gómez M, Vikas E, Zhang Y. [Full citation details missing – please provide article title, journal name, volume, pages, and year.]
32. Chowdhury SA, Islam J, Rahaman MM, Rahman MM, Rumzhum NN, Sultana R, Parvin MN. Cytotoxicity, antimicrobial and antioxidant studies of the different plant parts of *Mimosa pudica*. *Stamford J Pharm Sci*. 1970;1(1):80–84. doi:10.3329/sjps.v1i1.1813
33. Aneesha V, Gopi S, Jose JR, Karan S, Snehaddevi M, Jeevanandham S, Anil AV. Formulation and evaluation of herbal antifungal nail lacquer for the treatment of onychomycosis. *World J Pharm Res*. 2024;13(1):1779–1790. doi:10.20959/wjpr20241-30876
34. Chukwu J, Ahuchaogu A, Ukaogo P, Obike A, Echeme J. Antifungal activity of *Mimosa pudica*, isolation and NMR characterization of bioactive components. *Asian J Chem Sci*. 2017;2:1–5. doi:10.9734/AJOCS/2017/34744
35. Sunil M, Nagakrishna L, Maity S, Pyadala N, Malleshaddi PC, Gootthy SS, Polavarapu R. Evaluation of antibacterial activity of ethanolic extracts of *Mimosa pudica* leaves. *Mintage J Pharm Med Sci*. 2016;5:25–27.
36. Rani C, Theja I, Banoth RK. Formulation and evaluation of antifungal herbal nail lacquer for the treatment of onychomycosis. *J Xidian Univ*. 2023;16:710–723. doi:10.37896/jxu16.12/066
37. Sudaxshina M. Design of antifungal nail lacquer formulations containing antifungal. *Sci Pharm*. 2012;622:29.
38. Patil HI, Awati AS, Mujumale DN. Formulation and evaluation of herbal nail lacquer for treatment of onychomycosis. *Int J Biol Med Res*. 2023;14(4):7643–7647.
39. Verma NK, Singh AK, Mall PC, Yalar V, Jaiswal R, Dwivedi KP, Gupta AK, Kunnar S. Nail drug delivery: A review. *South Asian J Pharm*. 2020;9(6):62–63. doi:10.36347/sajp.2020.v09604.002.



HOW TO CITE: Anjali Bawaskar*, Vishal Keshewar, Pallavi Korde, Komal Pathade, Dr. Shivashankar Mhaske, Vinod Chaware, Shraddha Saubhage, Formulation And Evaluation of Herbal Essential Oil-Based Nail Lacquer for Management of Onychomycosis, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 5, 4006-4027. <https://doi.org/10.5281/zenodo.15504772>

