FORMULATION AND EVALUATION OF ANTIFUNGAL NAIL POLISH

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ABSTRACT

The present study focuses on the formulation and evaluation of an antifungal nail polish incorporating *C.Ternatea* extract, a plant known for its antimicrobial and antioxidant properties. The primary aim was to develop a cosmetically acceptable nail lacquer capable of delivering antifungal activity directly to the nail surface, potentially aiding in the treatment of onychomycosis. Ethanolic and water extracts of *C.Ternatea* flowers were prepared and incorporated into a nitrocellulose-based nail polish formulation. The formulated lacquer was evaluated for physicochemical parameters such as drying time, gloss, smoothness, viscosity, and non-volatility. Antifungal efficacy was assessed using the agar diffusion method against common fungal pathogens including Candida albicans and Aspergillus Niger. The formulation showed promising antifungal activity along with acceptable cosmetic properties, indicating that *C.Ternatea* extract-based nail polish may serve as a natural, topical antifungal agent with dual therapeutic and aesthetic benefits.

Keypoints: antifungal, antimicrobial and antioxidant activity, Aspergillus Niger, nitrocellulose-based.

INTRODUCTION

Nail Polish

It is one of the most popular beauty products worldwide. In 2011 alone, U.S. consumers spent approximately $6.6 billion on nail enhancement. The history of nail polish dates back to 3000 B.C., Nail polish is a liquid that is applied to fingernails and toenails to decorate and protect them. It is made from a mix of an organic polymer and other ingredients that give it color and texture.

Herbal nail polish is a type of nail enamel that does not contain many of the harmful chemicals found in regular nail polish. It is free from formaldehyde, toluene, artificial colors, xylene, and phthalates, which are commonly used in traditional nail polishes. The main ingredient in herbal nail polish comes from plant-based sources, making it a safer and more natural alternative to synthetic nail polishes. (Jilsha G; *et al*.2023).

Nail diseases are not typically life-threatening, but they can cause severe pain, discomfort in daily activities, and significant physical, psychological, and emotional effects, ultimately reducing a person's quality of life. (Muthukumar M 2023). Although numerous herbal formulations are available on the market, we propose developing a formulation that combines herbal active ingredients with safe, non-toxic artificial components. (Jilsha G. *et al,* 2023. The color, appearance, shape, and texture of nails can provide valuable insights into a person’s overall health and hygiene. Medical professionals routinely inspect nails to gather clues about underlying health conditions. Observing nails can reveal an individual's cleanliness, and abnormal nail conditions may be congenital. Changes in nails can result from minor factors or serious medical conditions, making professional evaluation essential for accurate diagnosis.

Causes of fungi on Nails: - Nail Psoriasis, Onychogryphosis, Onychomycosis, Onycholysis and Paronychia.

C. *Ternatea (CT)* also called as Clitoris principissae or Asian pigeon wings or butterfly pea (Raut S; *et al.* & Ashraf K; *et al.* 2024) It’s a species belonging to Fabaceae family. (Shinde N; *et al.* 2024). Ayurveda has made extensive use of the *C. Ternatea* plant. Pharmacologically, it has analgesic, anxiolytic, antifungal, antioxidant, antimicrobial and anti-inflammatory properties. (Sarma D; *et al*. 2023**)**.

Fig No.01. Image of C. Ternatea Flower

C. Ternatea has been commonly used in Ayurvedic medicine. Its improve memory, act as an antidepressant, provide sedation, reduce stress, anxiety, and induce a calming effect (Kumar *et al.* 2021 besides medicinal applications. The plant's ability to thrive in various soil conditions and its drought tolerance make it valuable in ecological restoration programs and agroforestry. (Rai *et al.* 2019).

MATERIALS

Clitoria ternatea plants Flowers and Legume will be collected from Local area of Palsoni (Wani).

METHODS

Drying and Grinding

- The collected flower of clitoria ternatea, were washed under running tap water to remove dust and dried at room temperature (25-30°C) for 10–15 days.
- The dried plant material was finely ground into a powder using an electric grinder and stored in airtight containers at normal room temperature.

Fig No.02. Drying and Grinding of *C. Ternatea* Flowers.

Extraction Procedure

Soxhlet Extraction Process

- 7 g of dried powder was extracted using water & ethanol (100%) in a Soxhlet apparatus for 3-4 hours.
- The cycle repeats for 3times for further extraction, after completion 4 cycle of extraction, the Extract is formed. (Camel V. 2001).
- The drug extracted with water gives purplish blue color & with ethanol gives green in color.
- The extract was filtered, Stored at 4°C for further analysis. (Camel V. 2001).

Antifungal Activity

The Agar plate media was prepared by heating, 2.8 g of nutrient agar powder with 100ml of distilled water to fully dissolve all components. Sterilized the dissolved mixture at 121^0 C for 15 minutes. Once the nutrient agar has been sterilized, allowed it to cool but not solidify. Then inoculated the selected microorganism in nutrient agar medium, mixed well and poured into petri plates and set aside on the sterile surface until the agar has solidified. In this cup-plate method/ agar well diffusion method, after solidification, holes about 9 mm in diameter are cut in the medium with a sterile borer. The antifungal agents (C. Ternatea extracts) directly placed in the holes. The zone of inhibition is observed after incubation period, at 30 to 35ºC for 2 to 3 days. Note the diameter for zone of inhibition was measured in millimeters. (Dr. Kokare Chandrakant 2013, Jeurkar MM, *et al.* 2019).

Phytochemical Screening

Detection of Saponins

1. Froth test: - Distilled water was used to dilute the extracts to 20ml, which was then agitated in a graduated cylinder for 15 minutes. The presence of saponins is indicated by the formation of a 1cm layer of foam.
2. Foam Test: - 2 ml of water and 0.5 gram of extract were mixed together. The presence of saponins is indicated if the foam formed lasts for 10 minutes.

Detection of Phenols

1. Ferric chloride Test: - Three to four drops of a ferric chloride solution were added to the extracts. Phenols are present when a bluish black colour forms.

Detection of Flavonoids

1. Alkaline Reagent Test: - Sodium hydroxide solution in a few drops was used to treat the extracts. When diluted acid is added to form a strong yellow colour, eventually turns colourless, indicating the presence of flavonoids.
2. Lead acetate Test: - A few drops of a lead acetate solution were added to the extracts. The presence of flavonoids is indicated by the precipitate's yellow colour. (Jeurkar MM, *et al*. 2022).

. Formulation

Preparation of Nail Polish

Sr. No	Name of the Ingredients	Property	F1 Water Extract	F2 Alcoholic Extract
1	Ethyl acetate	Film Forming agent	3ml	3ml
2	Gum acacia	Thickening agent	2.5g	2.5g
3	Titanium dioxide	Shining agent	0.50g	0.50g
4	Castor oil	Plasticizer	1.50ml	1.50ml
5	Extract	Antifungal activity	2.5ml	2.5ml

Table No. 01: Formulation of Nail Polish

Procedure

- Accurately weigh the film forming agent and transfer it into a beaker.
- Add the solvent and continuously stirring with mechanical stirrer.
- Add the thickening agent into it to form a smooth paste.
- Followed by the addition of antifungal activity and plasticizer.
- Mechanical stirrer until proper consistency is obtained. (Jilsha G, *et al.* 2023).

Evaluation Parameters:

Colour: - The nail polish colour is compared to a master colour standard by applying it to small sample areas (thumbnails).

Odour: - The odour of the nail polish was checked by manually (Jilsha G, *et al*. 2023).

Consistency: - The consistency was checked by applying on nail.

Grittiness: - The product was checked for the presence of any gritty particles by applying it on the nail.

PH: - The pH of 1% of sample solution of the formulation was measured by using calibrated digital pH metre at constant temperature.

Stability Test: - Nail polish stability is under observing through factors like color, viscosity, and drying time, is crucial for product quality. Good stability means the polish maintains its properties over time and storage, while poor stability can lead to issues like color fading, thickening, or separation.

Drying Time: - The drying time of the nail polish depends on how quickly its solvents evaporate. To test this, a thin layer of nail paint is applied to a clean glass plate. A stopwatch is used to measure the time it takes to dry completely, which should be under 1-3 minutes. The test is done in a controlled environment at 25°C with 50% humidity.

Spreadability: - The product was checked by applying on nails and it was easily spreaded.

Smoothness of Flow: - This test checks how smoothly the polish spreads and dries. A sample is poured to a height of about 1.5 inches, then spread on a glass plate. The way the polish flows and levels itself helps determine its smoothness.

Gloss: - The Nail paint was checked by applying on nails. (Patel S, et al. 2024).

RESULT & DISCUSSION

Detection of phytochemical screening

Tests	F1(Water extract)	F2(Ethanol)
I. Saponins Test		
a) Froth Test	+ve	+ve
b) Foam Test	+ve	+ve
II. Phenols Test		
a) Ferric Test	+ve	+ve
III. Flavonoids Test		
a) Alkaline Reagent Test	+ve	+ve
b) Lead Acetate Solution	+ve	+ve

Table No. 02. Phytochemical screening of water and Ethanolic Extracts of *C. Ternatea*

The phytochemical screening of water (F1) and ethanolic (F2) extracts of *C.Ternatea* revealed the presence of various bioactive compounds. Both extracts gave positive results for saponins. Phenolic, flavonoids as confirmed. Overall, these findings suggest that ethanol and water are more effective solvent.

Antifungal Activity against Gram +ve Gram -ve (S. aureous & E. coli.)

The extract of *C. Ternatea* flowers were subjected to preliminary phytochemical screening for detection of chemical constituents present in them. In the preliminary phytochemical screening, the presence of alkaloids, phenols, flavonoids, tannins & saponin were reported in the extracts.

The antibacterial, antifungal, and the percentage inhibition of the ethanol and aqueous flowers extracts of C. Ternatea were evaluated in the present research work. The study of in vitro antifungal activity is in important step towards the development of new potential antifungal drugs. In the present study, the ethanol flowers extract of C. Ternatea exhibited the highest antifungal activity and water extract showed minimum activity against two bacterial strains E. coli, & S. aureus.

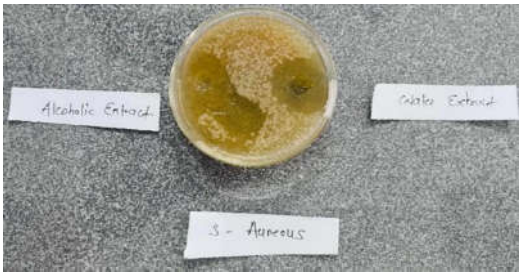

Fig No. 07. & 08. Zone of inhibition (Diameter in mm)

ZONE OF INHIBITION:

Extract (C. Ternatea)	**E. coli**	**S. aureus**
A (water)	6.02mm	7.0mm
B (ethanol)	7.4mm	7.8mm

A: water, B: ethanol. Diameter of inhibition zone in mm

Evaluated Parameter for Nail Polish.

Sr. No.	**Evaluation Parameter**	**Formula 1 (water extract)**	**Formula 2 (Ethanol extract)**
1	Colour	Purple	Green
2	Odour	Distinct	Distinct
3	Consistency	Viscous	Viscous
4	Grittiness	Nil	Nil
5	PH	5.5 to 6	5 to 5.7
6	Stability Test	1 to 2 months	1 to 6 months
7	Drying Time	4-5 min	1-2 min
8	Spreadability	Easily spread	Easily spread
9	Smoothness to flow	Moderate	Easy to flow
10	Gloss	Dull shine	Bright shine

Table No. 05: Evaluation Parameters

The evaluation parameters for the two formulations, water extract (Formula 1) and ethanol extract (Formula 2), vary in several aspects. So, outcomes found that Formula 1 provides a dull shine, whereas Formula 2 has a bright shine, indicating a noticeable difference in gloss.

CONCLUSION

The overall of this research work refers the Antifungal potential of the flowers of C. Ternatea. The Antifungal assay of the ethanol and water extract of C. Ternatea flowers showed a significant antifungal activity. Present antifungal study of the C. Ternatea flowers showed that this plant possesses better antibacterial and antifungal activity which is more in ethanol extract than water extract. C. Ternatea flowers extract has been formulated for the treatment of various diseases of nail. Among two formulations, the F2 formulation exhibited good drying time, thickness, water resistance, non-volatile content, drug release, and zone of inhibition. The nail polish of F2 formulation was found to be potent in inhibiting the development of fungi. C. Ternatea gave desired zones of inhibition due to the presence of flavonoids and phenols. So, we can accomplish that the nail polish conceivably solitary innovative dosage forms that can transfigure the medicinal and health care sector.

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