IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

DESIGN AND DEVELOPMENT OF HERBAL NAIL LACQUER FOR THE TREATMENT OF ONYCHOMYCOSIS

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ABSTRACT

Herbal nail lacquer is a type of nail polish formulated with natural, plant-based ingredients. the utilization of herbal extracts, essential oils, or other natural compounds. Onychomycosis is an infection of the nail due to fungi that include dermatophytes, non-dermatophyte molds, and yeast (Candida species). More than 90% of cases have this dermatophyte infection, which is mostly brought on by trichophyton rubrum and Candida species. Herbal nail lacquer has been designed and developed in this study for the treatment of onychomycosis. An oleuropein compound found in olive leaves has shown potential as an antifungal agent. Incorporating it into herbal nail lacquer could aim to achieve effective treatment against onychomycosis. It was anticipated that this would increase patient preference as well as potency. The nail lacquer preparation was designed by maceration for extraction and simple mixing and analysed for thin layer chromatography, gloss, smoothness to flow, viscosity, water resistance test, drying time, and determination of antifungal studies. In this study, the formulation was prepared by using Eudragit RL-100, ethyl acetate, ethyl cellulose, dibutyl phthalate, salicylic acid, acetone, Clitoria ternatea (a coloring agent), and alpha-santalol (a smelling agent). The prepared medicated nail lacquer was evaluated for various parameters such as organoleptic characters, drying time, smoothness of flow, gloss, and water resistance that showed satisfactory results. Among all formulations, the F4 formulation was highly effective due to its good water resistance (0.05 g), quick drying time (60 s), good film thickness (0.14 mm), good viscosity (147 cp), and best zone of inhibition. From the above studies, it can be concluded that medicated nail lacquers proved to be a better tool as a drug delivery system for the transungual drug delivery of an antifungal in the treatment of onychomycosis. It can also be used for the beautification of nails with ease of application.

Key words: Onychomycosis, oleuropein, herbal nail lacquer, anti-fungal agent

INTRODUCTION

In recent times, the administration of medications to the human body through several channels, such as oral, parenteral, topical, inhalation, etc., has been the method used to treat illnesses. Every medical issue requires a precise and suitable course of action. In fact, it is believed that the fundamental objective of any therapy is to treat the patient's illness with the least amount of negative impact on their health. Furthermore, a detailed understanding of the pharmacokinetics and pharmacodynamics of the chosen medicine is necessary for an effective treatment strategy. As a result, we work tirelessly every day to improve our methods and technology and conduct research in order to create the finest possible treatment that will both hasten the

patient's recovery and ensure their safety. Human nails serve purposes beyond only being ornamental and protective. Human nails can be thought of as an additional drug delivery route in addition to their defensive and aesthetic functions, particularly in the case of nail illnesses like psoriasis and onychomycosis. These nail disorders are common in the general public, especially in older and immune compromised individuals. The active medication was administered to the nail in order to effectively treat nail disease. Conventional methods for identifying fungal organisms in the nail plate of patients with onychomycosis include direct microscopy, fungal culture, and histopathology. Surgical pathology testing, etc. Newer methods for diagnosing onychomycosis include polymerase chain reaction, phase contrast, hard x-ray microscopy, etc.

ONYCHOMYCOSIS

• It is an infection of the nail due to fungi that include dermatophytes, non-dermatophyte molds, and yeast (Candida species).

• These dermatophyte infections, mostly caused by Trichophyton rubrum and Candida species, are observed in over 90% of cases.

• Infected nails are thick and discolored, which leads to both physical pain and psychological stress.

CLASSIFICATION OF ONYCHOMYCOSIS

- Distal and lateral subungual onychomycosis (DLSO).
- Superficial white onychomycosis (SWO).
- Proximal subungual onychomycosis (PSO).
- Candida onychomycosis.
- Total dystrophic onychomycosis.

Commonly used treatments for onychomycosis:

1. Topical Antifungal Agents
2. Lasers
3. Photodynamic Therapy
4. Miscellaneous

NAIL LACQUER

Human fingernails and toenails can be decorated and/or protected by applying nail polish or nail varnish. Traditional nail lacquers have been beautifying and protecting nails for a very long time as cosmetics. Modern cosmetic treatments include topical nail preparations like lacquers, enamel, and varnish. In addition to shielding the nail plate, it adds shine and color to improve its attractiveness. It is possible to employ nail lacquer as a drug delivery mechanism for medications with low oral bioavailability. Since they are easily removed by rubbing, whipping, and washing, the topical formulations that are typically used in dermatology (creams, oil-based lotions, and powders) are not particularly adapted to the nail, and their impermeance at the application site easily explains their inefficacy.

CLASSIFICATION OF NAIL LACQUER

It can be categorized based on various criteria such as finish, formulation and function,

 Categorized by finish:
1. Matte finish nail lacquer
2. Glossy finish nail lacquer
3. Shimmer finish nail lacquer
4. Glitter finish nail lacquer
5. Crackle finish nail lacquer
6. Holographic finish nail lacquer

 Categorized by formulation:
1. Regular Nail Lacquer
2. Gel Nail Lacquer
3. Hybrid Nail Lacquer
4. Thermal Nail Lacquer
5. Neon Nail Lacquer

 Categorized by Function:
1. Base Coat Nail Lacquer
2. Color Coat Nail Lacquer
3. Top Coat Nail Lacquer
4. Antifungal Nail Lacquer
5. Nail Strengthening Lacquer
6. Nail Growth Stimulating Lacquer
7. Nail Hydration Lacquer
8. Topical Medicinal Nail Lacquer

 Categorized by pharmaceutical criteria:
1. Antifungal Nail Lacquers
2. Topical Medicinal Nail Lacquers
3. Nail Strengthening Lacquers
4. Nail Growth Stimulating Lacquers
5. Breathable and Permeable Lacquers
6. Repair and Recovery Lacquers:
7. UV Protective Lacquers
8. Nail Hydration Lacquers

CONSTITUENTS OF NAIL LACQUER

- The basic nail varnish consists of solvents, film-forming polymers, resins that enable the film to adhere to the nail plate and convey shine to the film, plasticizers that give flexibility and durability to the film, colouring agents, and suspending agents.

HERBAL NAIL LACQUER

Herbal nail lacquer is a type of nail polish formulated with natural, plant-based ingredients. Unlike conventional nail lacquers, which often contain synthetic chemicals and potentially harmful substances, herbal nail lacquers prioritize the use of herbal extracts, essential oils, and other natural compounds. These products aim to offer both aesthetic and health benefits while minimizing environmental impact and chemical exposure.

AIM AND OBJECTIVES

Aim:

The aim of the study is to design and development of herbal nail lacquer for the treatment of onychomycosis.

Objectives:

- To prepare a nail lacquer formulation using an antifungal drug.
- To evaluate the prepared formulation of medicated nail lacquer.
- To study the effectiveness of formulation

METHODOLOGY

EXTRACTION OF OLEUROPEIN FROM OLIVE LEAF POWDER:

Leaf Powder

Mixing
(Ethanol + Water)

Maceration 24 – 48 hrs

Filtration

Oleuropein liquid extract

Evaporation

Oleuropein extract

PROCEDURE: MACERATION METHOD

50g of olive leaf powder was taken in a beaker

Add the solvent to the beaker 500ml (350ml ethanol + 150 water)

Stir the mixture thoroughly to ensure the powder is fully submerged in the solvent

Macerate for 24 - 48 hours

After the maceration, filter the mixture using filter paper

Oleuropein liquid extract obtained from the solid residue

The liquid extract can be evaporated

Oleuropein extract was obtained

FORMULATION OF HERBAL NAIL LACQUER:

Weighing

Eudragit RL-100
+
Ethyl cellulose
mixing

Adding Ethyl
acetate

Mixing to
dissolve Eudragit
RL-100 and Ethyl
cellulose

Then Salicylic acid
+
Dibutyl phthalate
added

Continuously
stirring

Form a clear nail
lacquer base

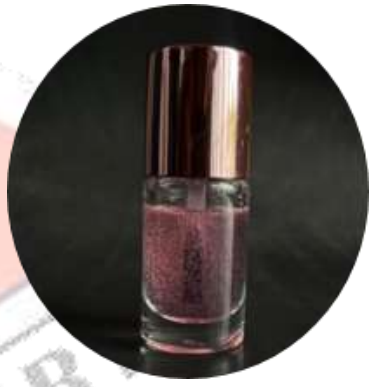
Oleuropein extract
mixed with acetone

Mix the two Solutions together

Combination was incessantly agitated 100 rpm using a magnetic stirrer

Few drops of colouring agent (clitoria ternatea)
+
smelling agent (sandal wood oil) is added

Again, agitated using a magnetic stirrer



Herbal nail lacquer is prepared and stored tightly in a container

PROCEDURE:

Suitable amount of eudragit RL 100 and ethyl cellulose are weighed and mixed in a beaker

Then add suitable amount of ethyl acetate was used to dissolve the mixture

Then suitable amount of salicylic acid and dibutyl phthalate added

Continuously stirring results formation of clear nail lacquer base

Take oleuropein extract and mixed with acetone is added to the clear nail lacquer base

This combination was agitated using a magnetic stirrer at 100rpm

Then Few drops of colouring agent (clitoria ternatea)
+
smelling agent (sandal wood oil) is added

Again, agitated using a magnetic stirrer

Herbal nail lacquer is successfully prepared and stored tightly in a container

COMPOSITION TABLE

INGREDIENTS	F1	F2	F3	F4
Oleuropein(ml)	2	2	2	2
Eudragit RL - 100(g)	2	3	3.5	4
Ethyl cellulose(g)	0.2	0.50g	0.75	1
Ethyl acetate(ml)	2	2	2	2
Dibutyl Phthalate(ml)	0.4	0.4	0.4	0.4
Salicylic acid(ml)	2	2	3.5	5
Acetone(ml)	qs	qs	qs	qs
Alpha-santalol (Santal um album)	qs	qs	qs	qs
Clitoria ternatea	qs	qs	qs	qs

EVALUATION TESTS

1. EVALUATION OF OLEUROPEIN

1. **Thin layer chromatography:** The TLC procedure involves preparing a TLC plate, preparing the sample, and applying the oleuropein extract. The mobile phase is prepared using a solvent system like ethyl acetate: formic acid: water. The spotted TLC plate is placed in the developing chamber, and the solvent rises up the plate. The plate is then dried and a reagent like ferric chloride is used to form colored complexes. The presence of oleuropein is confirmed by matching the Rf values and visual characteristics with the standard.

2. EVALUATION OF HERBAL NAIL LACQUER

1. **Organoleptic Evaluation:** Different physical features such as colour, odour and appearance were examined for organoleptic properties.

2. **Drying time:** An area is marked on glass petri dish to which a film of nail lacquer formulation was applied with the help of brush. The time taken for the film to dry was noted using a stopwatch. The readings were obtained in triplicate.

3. Lacquer film thickness: One ml of formulation was spread equally with an applicator brush in 8 cm diameter petridish and was allowed to dry at room temperature. After drying nail lacquer film was isolated from the petri dish. The film thickness was measured at three different places using a micrometer screw gauge and average was calculated**.**

It was measured by using: -

$$\text{Determination of pitch} = \frac{\text{Distance moved by pitch}}{\text{Number of full rotations given to screw}}$$

$$\text{Least count} = \frac{\text{Pitch}}{\text{Number of divisions on the circular scale}}$$

4. Smoothness to flow: Each formulation's nail lacquer was poured into a separate glass plate from a height of 1.5 inches, spread out, and made to rise vertically before being prominently examined for film smoothness

5. Gloss: The gloss was observable after the nail lacquer formulation was applied over the nail.

6. Viscosity: A viscometer may be used to check the viscosity of nail lacquer. Viscosity was determined using Brookfield Viscometer, model LVF at room. Temperature using spindle No.3 at 20 rpm.

7. Water resistance test: This test was performed to measure the resistance of nail lacquer towards water. A continuous film of lacquer was applied on the petri dish, dried and then water was poured on it to immerse the film. As the polymer concentration increases the water resistance also increases i.e. the amount of water absorbed by the nail lacquer film after keeping in water for 24 hours should be less. The weight of petri dish was taken before and after immersion and increase in weight was calculated.

8. Determination of antifungal studies: Antifungal activity was assessed using the cup-plate tactic in Candida albicans. The culture was kept alive using Sabouraud's agar slants. 20 ml of pulverized Sabouraud's agar medium was incorporated into the Petri plates, alongside 0.2ml of a Candida albicans suspension, and set aside for 15 minutes. The Petri plate cups (10mm in diameter) were punched, and 0.08 ml of the sample solution was placed within them. Furthermore, include marketing nail lacquers as standard. The zone of inhibition was measured and compared to the standard formulation. The plates were kept at 40°C for 1 hour for diffusion before being incubated at 30°C for 48 hours. The zone of inhibition in millimetres was measured after the incubation period was completed**.**

RESULT

TLC TEST

Test sample of oleuropein:

Rf Value = Distance travelled by solute / Distance travelled by solvent

- Rf value of standard reference value of oleuropein =0.62
- Rf value of test sample of oleuropein = 4/6.5 = 0.61

Table 1: ORGANOLEPTIC EVALUATION

PARAMETERS	F1	F2	F3	F4
Color	Pale pink	Dark pink	Bright pink	Bright pink
Odor	Strong and woody odour	Strong and woody odour	Sweet woody odour	Sweet woody odour
Appearance	Turbid	Slightly transparent	Slightly transparent	Transparent

Table 2: DRYING TIME

FORMULATIONS	DRYING TIME (s)
F1	76
F2	70
F3	66
F4	60

TEST	F1	F2	F3	F4
Drying time	More drying time	Slow drying time	Less drying time	Less drying time

Table 3: LACQER FILM THICKNESS

FORMULATIONS	FILM THICKNESS (mm)
F1	0.058
F2	0.079
F3	0.13
F4	0.14

Table 4: SMOOTHNESS TO FLOW

FORMULATIONS	SMOOTHNESS TO FLOW
F1	Less smoothness
F2	Less smoothness
F3	Smooth
F4	Good smoothness

Table 5: GLOSS

FORMULATION	GLOSS
F1	No gloss
F2	Less gloss
F3	Glossy
F4	Glossy

Table 6: VISCOSITY

FORMULATION	VISCOSITY (cp)
F1	94
F2	108
F3	135
F4	147

Table 7: WATER RESISTENCE TEST

FORMULATION	WATER RESISTENCE (g)
F1	0.68
F2	0.24
F3	0.16
F4	0.05

TEST	F1	F2	F3	F4
Water resistance	Poor water resistance	Less water resistance	Less water resistance	Good water resistance

Table 8: ZONE OF INHIBITION

FORMULATION	ZONE OF INHIBITION	
	PREPARED NAIL LACQUER	MARKETED AMROLIFINE NAIL LACQUER
F1	14	17
F2	15	17
F3	17	18
F4	18	18

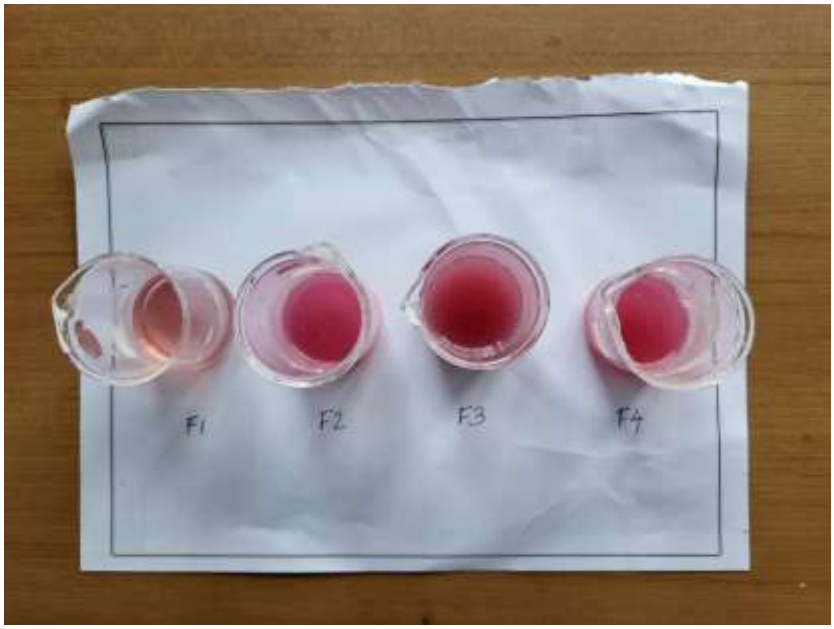


Figure 1: ORGANOLEPTIC EVALUATION

Figure 2: LACQUER FILM THICKNESS

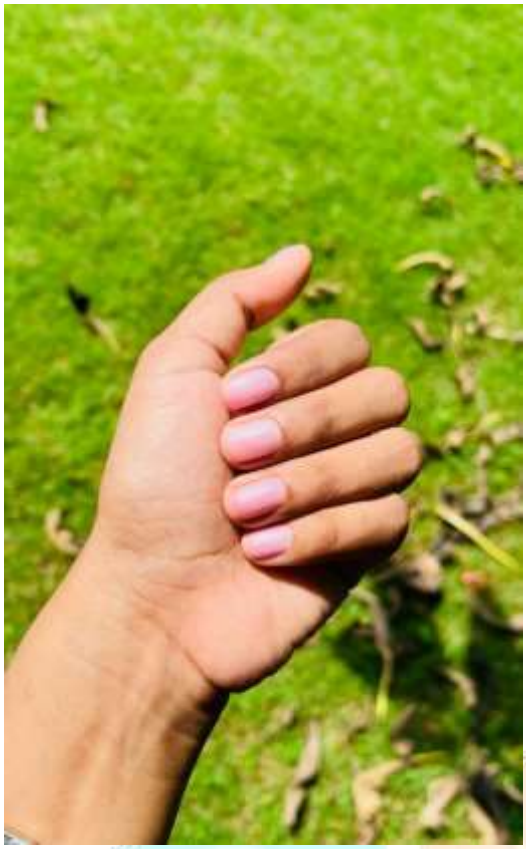


Figure 3: GLOSS

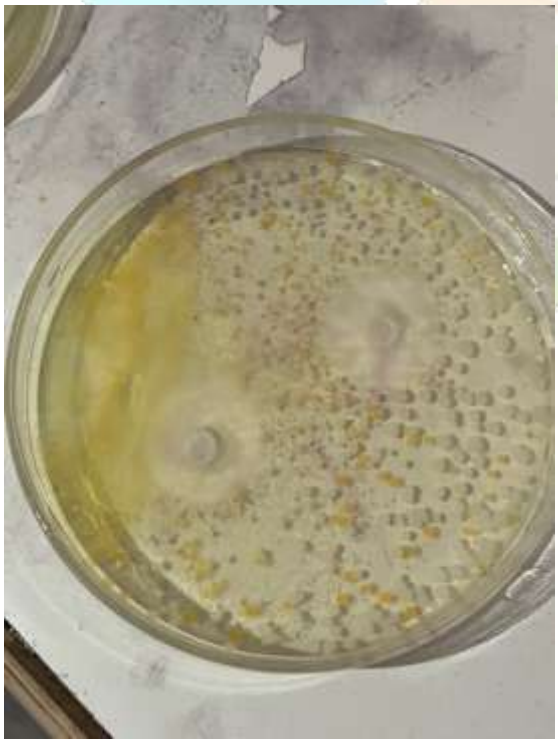


Figure 4: ZONE OF INHIBITION

DISCUSSION

1. THIN LAYER CHROMATOGRAPHY

The extraction of oleuropein from olive leaves using maceration was successfully performed. The TLC analysis confirmed the presence of oleuropein in the extract, as indicated by the similar Rf values for the standard and the sample. This method provides a simple and effective way to extract and identify oleuropein from olive leaves, which can be utilized for the formulation of herbal nail lacquer.

2. ORGANOLEPTIC EVALUATION

Organoleptic evaluation for various sensory characteristics like colour, odour, appearance, etc. was noted (Table 1). The results from the four formulations are consistent. These parameters colour, smell, and appearance provide nails with an elegant appearance that increases consumer acceptance.

3. DRYING TIME

The drying rate from F4 to F1 increases from 60 sec to 76 sec (Table 2). Formulation F4 showed a relatively short drying rate because it consists of a larger amount of polymer concentration with a rise in viscosity, which tends to result in a short drying time that was appropriate for the individual to keep the nail wet with nail lacquer for a shorter time. The implementation and concert attributes of nail covering are hugely affected by the volatility features of its specific solvent and consequently, its drying time. As the polymer concentration increases drying time is increased.

4. LACQUER FILM THICKNESS

Regarding drying, the thickness of all preparations differed from 0.058 to 0.14mm. The results which were noticed have been presented in (Table 3). The thickness of the lacquer was revealed to be accurate throughout the formulations. The thickness of the F4 formulation shows great strength, more flexibility, and resistance toward water due to an increase in polymer and plasticizer concentration.

5. SMOOTHNESS TO FLOW

It was revealed that the nail lacquer spread and developed a smooth, uniform film on the glass plate. All formulations showed good smoothness due to lower polymer concentration (Table 4).

6. GLOSS

Among all formulations, the glossiness was found to be good in the F4 formulation as can be observed (Table 5). Glossiness is regarded as being essential for providing the patient with nail lacquer that has been cosmetically appealing.

7. VISCOSITY

The viscosity of all formulations is listed in (Table 6). Formulations F2, F3, and F4 show good results due to an increase in polymer concentration. The viscosity of the formulation increased as polymer concentration increased. The viscosity of the formulation differs from 100 to 220 centipoises while it was noticed that 94 to 147 centipoises resulted in clear and glossy. Viscosity beyond this range results in clouding and diminishes cluster, which is inappropriate from a decorative perspective.

8. WATER RESISTANCE

Here F4 formulation has comparatively low weight and better water resistance. The data were mentioned in (Table 7). Throughout the presence of water, the F4 preparation didn't show any cloudiness, scorching, or mass variation. It was found that increasing the concentration of polymer and plasticizer in the preparation risen its resistivity to water.

9. ANTIFUNGAL ACTIVITY

All formulations' zones of inhibition were measured, and it was discovered that they ranged from 14 to 18 mm, which is similar to that of marketed nail lacquer. Optimized formulation F4 and marketed nail lacquer show a zone of inhibition of about 18mm (Figure 4). Results are reported in (Table 8). This indicates that formulations don't affect any zone of inhibition on nail lacquer. The effectiveness of the extract's antifungal activity was discovered. The effectiveness of the extract's antifungal activity was determined against C. Albicans due to the presence of flavonoids and phenols. A Petri plate with optimized F4 preparation that contained extract illustrated the same result (zone of inhibition) along with the marketed Amrolifine nail lacquer formulation. Therefore, the F4 formulation shows good antifungal activity.

SUMMARY AND CONCLUSION

- The aim of the present investigation was to formulate and evaluate the herbal nail lacquer as a transungual drug delivery system for the treatment of onychomycosis.
- Olive leaf has been formulated for the treatment of onychomycosis. Oleuoropein is one of the major components in the olive leaf. It has high antifungal properties, so it is used for the treatment of onychomycosis caused by Trichophyton rubrum.
- The formulation was prepared by using Eudragit RL-100, ethyl acetate, ethyl cellulose, dibutyl phthalate, salicylic acid, acetone, a coloring agent, and a smelling agent.
- The prepared medicated nail lacquer was evaluated for various parameters, such as organoleptic characters, drying time, smoothness of flow, gloss, and water resistance, and showed satisfactory results.
- Among all formulations, the F4 formulation was highly effective.
- From the above studies, it can be concluded that medicated nail lacquers proved to be a better tool as a drug delivery system for the transungual drug delivery of an antifungal in the treatment of onychomycosis.
- Apart from treating nail infections, medicated nail lacquers can also be used for beautifying nails with ease of application.
- This improves patient compliance and acceptability.

REFERENCES

[1] On the in-vitro antimicrobial activity of oleuropein and hydroxytyrosol. Journal of Pharmacy and Pharmacology, 51(8), Bisignano. G., Tomaino, A., Lo Cascio, R., Crisafi. G., Uccella. N., & Saija, A, 1999 [Link](https://pubmed.ncbi.nlm.nih.gov/10504039/]

[2] Effect of solvent on the penetration of ciclopirox from lacquer formulations into the human nail plate in vitro. Journal of Cosmetic Science. Gunt, H. B., & Kasting, G. B. Page no. 477-484, 2007 [Link](https://pubmed.ncbi.nlm.nih.gov/18038275/).

[3] Handbook of pharmaceutical excipients 6th edition by Raymond c Rowe, Paul J Sheskey and Marian E Quinn Page no.253-262.

[4] Formulation and evaluation of an antifungal nail lacquer for onychomycosis. British Biomedical Bulletin 2014;2 Vipin KV, Sarath CC, Ann RA, Premaletha K, Kuriakose MR, Page no.242-248, 2014

[5] Bilayered nail lacquer of terbinafine hydrochloride for treatment of onychomycosis. Journal of Pharmaceutical Sciences. Shivakumar H N, Vaka S R, Madhav N S, Chandra H, Murthy S N. Page no. 4267-76, 2010

[6] British Journal of Dermatology. Roberts DT, Taylor WD, Boyle J, Page no. 402-410, 2003

[7] Richardson M. British Association of Dermatologists' guidelines for the management of onychomycosis. British Journal of Dermatology. Ameen M, Lear JT, Madan V, Mohd MMF, Page no. 937-58, 2014

[8] Transungual permeation of the voriconazole nail lacquer against Trichophyton rubrum. Journal of Drug Delivery and Therapeutics. Tandel AA, Agrawal S, Wankhede SS, Page no. 112-145, 2012

[9] Akhtar N, Sharma H, Pathak K. Onychomycosis: Potential of nail lacquers in transungual delivery of antifungals. Scientifica. Akhtar N, Sharma H, Pathak K, Page no. 1-12, 2016

[10] Thatai P, Sapra B. Terbinafine hydrochloride nail lacquer for the management of onychomycosis: Formulation, characterization and in vitro evaluation. Therapeutic Delivery. Thatai P, Sapra B, Page no. 99-119, 2018

[11] Drug delivery through nails: Present and future. New Horizons in Translational Medicine. Shanbhag PP, Jani U, Page no.252-263,2017

[12] Transungual permeation: Current insights. Drug Delivery and Translational Research. Bhuptani RS, Deshpande KM, Patravale VB, Page no. 426-439, 2016

[13] Murdan S. Enhancing the nail permeability of topically applied drugs. Expert Opinion on Drug Delivery. Murdan S, Page no.1267-1282, 2008.