Development and evaluation of herbal fruit peel Nail lacquer as a natural remedy for nail fungal infections

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ABSTRACT:

Onychomycosis, a fungal infection of the nail, is also known by other names such as dermatophytes onychomycosis or Tinea unguium. This condition is caused by various pathogens, including dermatophytes, Candida, and non-dermatophytic molds. The antifungal potential of *Citrus sinensis* and *Punica granatum* fruit peels in a herbal nail lacquer was evaluated against the fungus *Candida albicans* in this research. The fruit peels of *Citrus sinensis* and *Punica granatum* have reported its antifungal activity against *Candida albicans*. A combination of these two plants has not been known for its activity against this fungus. Fruit peels were collected and their powdered extracts were used for the activity studies. Agar well diffusion method was employed to assess the antifungal activity of the herbal nail lacquer. Herbal nail lacquer formulation was prepared using 2%, 3%, 3.5%, and 4% of PVP as a film-forming agent. Test parameters for herbal nail lacquer like appearance, pH, gloss, smoothness, drying time, water resistance, and stability test were evaluated. The formulation, F4, was selected based on its evaluation parameters. The results of this study showed that fruit peel extracts and its nail lacquer had antifungal activity. A 10% extract concentration was selected due to its effective zone of inhibition. Additionally, the stability tests confirmed that all formulas remained stable for at least 30 day.

KEYWORDS: Fruit peel, herbal extract, Herbal nail lacquer, evaluation, Anti-fungal activity

INTRODUCTION

Onychomycosis, also known as tinea unguium, is a fungal infection that affects the nails of fingers or toes. This condition can cause thickening, discoloration, and separation from the nail bed. Any part of the nail unit, including the plate, matrix, or bed, can be affected. The term "onychomycosis" comes from the Greek words "onyx" (nail) and "mykes" (fungus). Approximately 10% of the general population is affected, with adults being more prone to it. It accounts for one-third of integumentary fungal infections and half of all nail diseases. Dermatophytes, such as Trichophyton rubrum, and non-dermatophytes, like Candida albicans, are the primary causes of onychomycosis[1-2].

Medicated lacquer preparations offer a valuable solution for treating fungal diseases, particularly by avoiding the oral toxicity associated with antifungal drugs. However, their development poses a significant challenge: effectively delivering the active concentration to the site of infection. To achieve this, a specially formulated vehicle is required to facilitate the penetration of topical antifungals through the nail plate, enabling transungual delivery. It's worth noting that the human body naturally hosts a variety of microorganisms, including bacteria and fungi, which can sometimes lead to infections that require such targeted treatments. The human body hosts a mix of microorganisms, with some being beneficial and others potentially causing infections. Fungi, in particular, thrive on dead tissues such as hair and nails. Prolonged exposure to warm, moist environments can increase the risk of developing nail infections. To combat this, it's crucial to explore ways to enhance nail penetration, which would be a significant step towards developing effective local treatments for fungal nail infections. Developing effective transungual delivery systems is complicated by the absence of standardized in vitro methods for assessing drug permeation through the nail plate, posing a major obstacle to advancement. Nail polish and varnish are popular cosmetics used to enhance the appearance and protect the health of fingernails and toenails. For years, conventional nail lacquers have been a staple in beauty routines, providing a decorative touch while also safeguarding the nail plate. Topical nail preparations, including lacquers, enamels, and varnishes, play a significant role in modern beauty and nail care regimens[3-4].

Herbal nail lacquer is a unique type of nail polish that harnesses the power of natural, plant-based ingredients. Unlike traditional nail lacquers, which often rely on synthetic chemicals, herbal nail lacquers prioritize the use of herbal extracts and essential oils. This approach not only promotes healthier nails but also reduces exposure to potentially harmful substances. By incorporating natural compounds, herbal nail lacquers aim to provide both aesthetic and health benefits. Additionally, these products tend to have a lower environmental impact, making them a more sustainable choice for nail care. Overall, herbal nail lacquers offer a refreshing alternative to conventional nail polishes, combining natural ingredients with a commitment to health and sustainability[5].

MATERIALS AND METHODS:

Materials

The materials such as Pomegranate peel, Orange peel were bought from organic shop(Alagappan Organic Shop TVT Chennai-19)Polyvinyl pyrrolidone, methyl cellulose, ethyl acetate, salicylic acid, dibutyl phthalate were bought from (lab chemicals old no.19, Nyniappa Naicken street, rattan Bazzar, park town Chennai-03).

Collection and authentication of samples

Dried fruit peels of *Citrus sinensis* and *Punica granatum were* used for the study. *Thespesia populnea* leaves were collected from Chennai, during January 2025 The sample drugs were authenticated and identified by Prof. P. Jayaraman at the Plant Anatomy Research Center in West Tambaram, Chennai, India. The both peels were air dried in shade and stored in polythene bags

Preparation of extracts by maceration method

The dried fruit peels of *Punica granatum* and *Citrus sinensis* were ground using mixer grinder and powdered to mesh size of # 40. The powdered drugs were then extracted by maceration. The extracts prepared were used for phyto-chemical study, formulation and evaluation. It is the simplest method of crude drug extraction and is official in IP 1985. The extraction process involves steeping the crude drug in ethanol, using a 1:10 drug-to-menstrum ratio, within a sealed container. Over 7 days, the mixture is occasionally shaken to ensure thorough contact. Afterward, the liquid is strained and pressed from the marc, then mixed and clarified through filtration to yield the final extract. The drug should be properly comminuted. The cellular structure gets penetrated and

the soluble portion are softened and dissolved. A closed vessel is recommended so as to prevent the loss of the menstrum as the degree of pressing the marc may vary, the final product is not adjusted to any fixed volume. The process takes upto 14 days for complete extraction. Sediment may form on standing; the fluid product should therefore be allowed to stand for few days for the complete evaporation of the solvent. By carrying the maceration process, the crude peel extracts of *Citrus sinensis* and *Punica granatum* was prepared[6] .Result of percentage yield of extraction was given in Table No:3

PHYTOCHEMICAL ANALYSIS

Qualitative Chemical tests

To identify the chemical constituents, the ethanolic extracts of Citrus sinensis and Punica granatum underwent a series of chemical tests. The specific methodologies used for these tests are outlined below.

Detection of Alkaloids

To test for alkaloids, the extracts were first dissolved in dilute HCl, then filtered, and the filtrate was analyzed.

a)Mayer's Test: Filtrate was treated with potassium mercuric iodide. A cream-colored precipitate was produced, indicated the presence of alkaloids.

b)Dragendroff's Test: Filtrate was treated with solution of potassium bismuth iodide. An orange-red precipitate showed the presence of alkaloids.

c)Wagner's Test: Filtrate was treated with Iodine in potassium iodide. A brown/ reddish brown precipitate showed the presence of alkaloids

d)Hager's Test: Here, the filtrate was treated with saturated picric acid solution. Formation of yellow colored precipitate showed the presence of alkaloids.

Detection of Carbohydrates

Extracts were dissolved in 5 ml distilled water and filtered. The filtrate was used to test for the presence of carbohydrates.

a)Molisch's Test: Filtrate was treated with 2 drops of alcoholic α-naphthol solution in a test tube and 2 ml of conc. sulphuric acid was added carefully along the side of the test tube. Formation of violet ring at the junction indicated the presence of carbohydrates.

b)Benedict's Test: Filtrate was treated with Benedict's reagent and heated on water bath. Formation of orange red precipitate indicated the presence of reducing sugars.

c)Fehling's Test: Filtrate was hydrolyzed with diluted HCl, neutralized with alkali and heated with Fehling's A and B solutions. Formation of red precipitate indicated the presence of reducing sugars.

d)Barfoed's Test: Extract was heated with Copper acetate in water and glacial acetate. production of red colour indicated the presence of reducing sugar.

Detection of Glycosides

Extracts were hydrolysed with dil. HCl and then subjected to test for glycosides.

Modified Borntrager's Test: The hydrolyzed extract was treated with ferric chloride solution and dilute HCl, then heated in boiling water for 5 minutes. After cooling, the mixture was combined with an equal volume of benzene and shaken. The benzene layer was then separated and treated with ammonia solution. A rose-pink color appearing in the ammoniacal layer confirmed the presence of anthranol glycosides.

Legal'sTest: To detect cardiac glycosides, the hydrolyzed extract was treated with sodium nitroprusside in pyridine. The appearance of a pink to blood-red color confirmed the presence of these compounds.

Liebermann Burchard's Test: To detect sterol aglycone, the hydrolyzed extract was first extracted with chloroform. The chloroform extract was then treated with acetic anhydride, boiled, and cooled. Upon adding concentrated sulfuric acid, a brown ring at the junction confirmed the presence of sterol aglycone..

Detection of Saponins

Foam Test: To test for saponins, the extract was diluted with distilled water and shaken in a graduated cylinder for 15 minutes. A 1 cm layer of foam forming and persisting after shaking suggested the presence of saponins.

Sodium bicarbonate test: The extract was tested for saponins by adding a few drops of sodium bicarbonate solution and shaking. The appearance of froth confirmed a positive result.

Detection of Tannins

Gelatin Test

A solution of 1% gelatin containing sodium chloride was added to the extract, and the formation of a white precipitate confirmed the presence of tannins.

Detection of Phenols

Ferric chloride Test: Extract was treated with few drops of ferric chloride solution. Formation of bluish black colour indicated the presence of phenols.

Detection of Flavonoids

a)Alkaline Reagent Test: Extract was treated with few drops of sodium hydroxide solution. Formation of

intense yellow colour, which becomes colorless on addition of dilute acid, indicated the presence of flavonoids.
b)Lead acetate Test: Upon adding a few drops of lead acetate solution to the extract, a yellow precipitate appeared, confirming the presence of flavonoids.
c)Shinoda Test: A few fragments of magnesium ribbon and concentrated HCl were added to the extract's alcoholic solution, and the subsequent appearance of a magenta color after a few minutes indicated a positive test for flavonoids.

Detection of proteins and amino acids

a)Xanthoproteic Test: Upon adding concentrated nitric acid solution to the extract, the appearance of a yellow color indicated a positive test for proteins.
b)Ninhydrin Test: The extracts were tested for amino acids by adding 0.25% ninhydrin reagent and boiling for a few minutes. The appearance of a blue color confirmed the presence of amino acids.
c)Biuret Test: To detect proteins, the extract was first heated with 10% sodium hydroxide solution, followed by the addition of 0.7% copper sulphate solution, which resulted in a purplish-violet color, indicating a positive test.

Detection of Triterpenes and Phytosterols

a)Salkowski's Test: To test for triterpenes and steroids, the extract's chloroform solution was mixed with concentrated sulfuric acid, shaken, and left to stand. The subsequent appearance of a golden yellow color confirmed their presence..
b)Libermann Burchard's Test: To detect phytosterols, the extract's chloroform solution was treated with acetic anhydride, boiled, and cooled. Upon adding concentrated sulfuric acid, a brown ring formed at the junction, confirming the presence of phytosterols.

Detection of Fixed Oils and Fats

a)Stain Test: To test for fixed oils and fats, a small amount of the extract was pressed between filter papers, and the resulting oily stain confirmed their presence.
b)Acetone-water Test: To detect resins, the extract was first dissolved in acetone and filtered. Upon adding a small amount of water and shaking, the solution became turbid, confirming the presence of resins[7].
Results of the chemical constituents of the extract are tabulated

Preformulation studies

Incompatibility study: Formulation stability relies heavily on the compatibility of the drug with excipients. Detecting potential chemical or physical interactions is essential, as these can influence the drug's bioavailability and overall stability.

Fourier Transform Infrared Spectroscopy

Fourier-transform infrared spectroscopy (FTIR) analysis An IR affinity spectrophotometer was used to enrol waves with an amplitude range of 450 to 4000 cm-1 in order to resolve the IR for nail lacquer with the goal of separating functional groups. FTIR spectroscopy was used to investigate the compatibility of the drug with excipients and polymers in the formulation at room temperature. The IR spectrum of the pure drug was recorded, and then physical mixtures of the drug with excipients (1:1 ratio) were prepared and analyzed for any potential interactions.[8]. The peaks are shown in table no 5,6and 17. Spectra are shown in graph no: 1, 2 and 3

Formulation of nail lacquer of fruit peel extract:

The formulated herbal mouthwash doesn't contain any colorant, perfume, anti-oxidant or preservative.

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. The extract was mixed with acetone was added to the clear nail lacquer base. This combination was agitated using a magnetic stirrer at 100rpm. Then Few drops of colouring agent (beet root powder) and few drops of orange oil is added Again, agitated using a magnetic stirrer. Herbal nail lacquer is successfully prepared and stored tightly in a container
To formulate a nail lacquer, four samples, designated as F1 to F4 were prepared as shown in table no 1. F1 to F4 were prepared by incorporation of 5%w/w of *Citrus sinensis* and *Punica granatum* fruit peel extract. 2,3,3.5,4 of PVP as film forming agent. Methyl cellulose was used as polymer. Ethyl acetate used as solvent to dissolve and blend the various ingredients in the nail lacquer, including polymers, resins, and pigments. Dibutyl Phthalate (DBP) was used as plasticizer. Salicylic acid was used as nail strengthening agent, helps to strengthen and harden the nail, making it less prone to breaking or splitting. Acetone reduces the viscosity of the nail lacquer, allowing for a smoother, more even application.
The ethanolic fruit peel extract of *Citrus sinensis* and *Punica granatum* were used for the preparation of nail lacquer. The same method was followed for the preparation of control nail lacquer as mentioned above9-12.

Table no 1: Formulation of Herbal nail lacquer

SL NO.	INGREDIENTS	F1 (%)	F2 (%)	F3 (%)	F4 (%)
1	Extract of *Citrus sinensis fruit peel*	5	5	5	5
2	Extract of *Punica granatum fruit peel*	5	5	5	5
3	Polyvinyl pyrrolidone(g)	2	3	3.5	4
4	Methyl cellulose(g)	0.2	0.45	0.75	0.50
5	Ethyl acetate(ml)	5	8	10	15
6	Dibutyl Phthalate(ml)	1	2	2.5	3
8	Lemon oil(ml)	qs	qs	qs	qs
9	Beet root powder (g)	qs	qs	qs	qs

Physico-chemical evaluation of herbalnail lacquer formulations:

The physical parameters of nail lacquer such as color, appearance and pH were checked. Other parameters of nail lacquer such as water resistance, drying time, were also evaluated.

(a)Organoleptic Evaluation:

Different physical features such as colour, odour and appearance were examined for organoleptic properties. The results are shown in Table no:8

(b)Smoothness to flow

The nail lacquer for each formulation was transferred from a 1.5-inch height into a different glass plate, spread out, and allowed to rise vertically before being closely inspected for film smoothness. The results are shown in Table no:8

(c)Gloss

After the nail lacquer formulation was put over the nail, the shine was visible. The results are shown in Table no:8

(d)Drying time:

The drying time of the nail lacquer formulation was determined by applying a film to a marked area on a glass petri dish and measuring the time it took to dry using a stopwatch, with triplicate readings taken for consistency. The results are shown in Table no:8

(e)Water resistance test: To evaluate water resistance, a dried film of nail lacquer was immersed in water, and the weight gain due to water absorption was measured over 24 hours. The test showed that nail lacquer films with higher polymer concentrations absorbed less water, demonstrating improved water resistance.The results are shown in Table no:8

(f) Lacquer film thickness

Nail polish films were prepared by applying 1 mL of each mixture to petri dishes and allowing them to dry at room temperature. The thickness of the cured films was measured using a micrometer screw gauge, with the average of three readings calculated for accuracy. The micrometer's precision was determined by calculating its pitch and least count based on the screw's specifications.[13-16]. The results are shown in Table no:8

Evaluation of formulated nail lacquer of pomegranate fruit peel extract and orange fruit peel extract for anti-fungal activity

Antifungal activity test:

Hydro- methanolic leaf extracts of Citrus *sinensis* and *Punica granatum* has been incorporated into a gel and studied for its antifungal properties. However, there are no reports regarding evaluation of antifungal activity of these herbs in combination. Hence the drug was evaluated for antifungal activity in *Candida albicans*.

Table no 2: Screening of antifungal activity

Organism	*Candida albicans*
Method	Kerby Bauer Cup plate method
Media	Potato Dextrose Agar Media
Standard	2% Ketoconazole
Test	Leaf extracts and its nail lacquer

Preparation of culture media

a) Preparation of potato dextrose agar:

About 20g peeled potato was pieced into cubes and boiled in 100 ml distilled water for 60 mintues, squeezed the pulp as much as possible through a fine cotton cloth. Then 2g of agar and 2g dextrose was added and makeup to 100ml by adding distilled water. Then the media was autoclaved at 15lbs pressure 121ºC for 20 minutes.

Screening by agar well diffussion method:

Potato dextrose agar was prepared. Then it was poured on sterilized petri plates and allowed to solidify. The fungal culture [*Candida albicans*] was swabbed over the plate. Then the wells are prepared by using sterilized borer. To that well different concentration of fruit peel extract (*Citrus sinensis* and *Punica granatum 1:1 in Di Methyl Sulphoxide solution)* with concentration 2 *µl, 5µl, 10µl* and following the addition of the standard 2% Ketoconazole solution, the plate was incubated at room temperature for 2-3 days. The resulting zone of inhibition was then measured and recorded in millimeters.[-18].

Stability study:

The goal of stability testing is to assess how drug quality changes over time due to factors such as temperature, humidity, and light. This information is used to determine the re-test period or shelf life and to specify storage conditions for drug substances and products.

Method: Placebo and the medicated nail lacquer were evaluated for their thermo stability. 100 mg of nail lacquer was taken into two 100ml beaker. One beaker was kept at room temperature, while another beaker was kept at 40^{o}c for one month. Nail lacquer was evaluated for its pH, appearance, drying time, smoothness to flow[19].

RESULT:

Collection and authentication of samples

Dried fruit peels of *Citrus sinensis* and *Punica granatum* was used for the study was collected from Chengalpattu district, Chennai, Tamilnadu. Authentication of the sample drug was conducted by Prof. P. Jayaraman, a specialist at the Plant Anatomy Research Centre, located in West Tambaram, Chennai, India.

Preparation of the extracts by maceration method

The fruit peels of *Citrus sinensis* and *Punica granatum* macerated and evaporated. % yield of the extracts was calculated and results are shown in **Table no:3**

Table 3: Data showing percentage extraction yield of fruit peels of *Citrus sinensis* and *Punica granatum*

SI No.	Maceration method	% yield of Ethanolic extracts
1	***Citrus sinensis* peel**	10.28
2	***Punica granatum* peel**	11.04

PHYTOCHEMICAL ANALYSIS

7.5.1. Qualitative chemical test: The extracts underwent qualitative evaluation to identify the chemical constituents present. Results are tabulated in Table no:8

Table:4 Qualitative chemical tests of the methanolic extract of *Citrus sinensis* and *Punica granatum*

Chemical constituents	Tests	Ethanolic extract- *Citrus sinensis*	Ethanolic extract- *Punica granatum*
		Maceration	Maceration
Alkaloids	Meyers test	-ve	+ve

	Dragendroff's test	+ve	+ve
	Wagner's test	-ve	+ve
	Hager's test	-ve	+ve
	Molisch's test	+ve	+ve
Carbohydrates	Benedict's test	+ve	+ve
	Fehling's test	+ve	+ve
	Barfoed's test	+ve	+ve
Glycosides	Modified Borntrager's test	+ve	+ve
	Legal's test	+ve	+ve
	Liberman burchard's test	+ve	+ve
Saponin	Foam test	+ve	+ve
	Sodium carbonate test	-ve	
Tannins	Gelatin test	+ve	+ve
Phenols	Ferric chloride test	+ve	+ve
Flavonoids	Alkaline reagents	+ve	+ve
	Lead acetate	+ve	+ve
	Shinoda test	+ve	+ve
Protein And Amino Acid	Xanthoproteic test	-ve	-ve
	Ninhydrin test	-ve	-ve
	Biuret test	-ve	-ve
Triterpenes And Phytosterols	Salkowski's test	+ve	+ve
	Liberman burchard's test	+ve	+ve
Fixed oil	Stain Test	-ve	-ve
Resin	Acetone-water Test	+ve	+ve

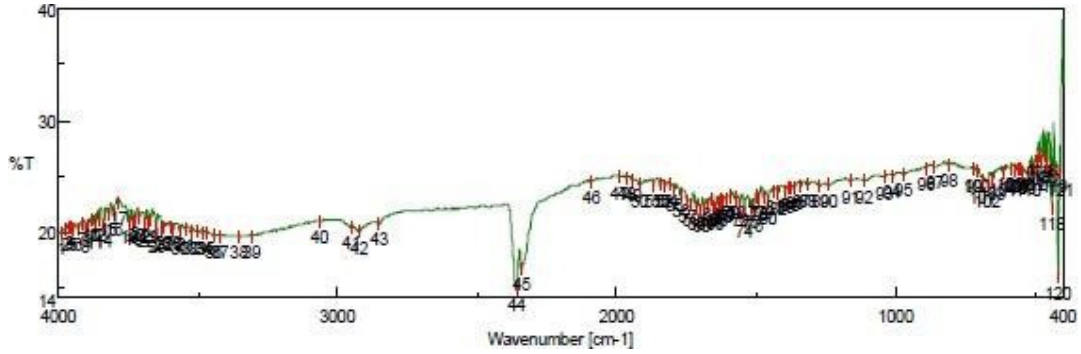
The presence of phytoconstituents is indicated by "+" (positive result), while their absence is indicated by "-" (negative result). In Ethanol fraction of ***Citrus sinensis*** contain alkaloid, glycoside, phenols, saponin, carbohydrates, flavanoids, tannins, triterpenes and phytosterols,resin.
In Ethanol fraction of ***Punica granatum*** contain alkaloid, glycoside, phenols, saponin, carbohydrates, flavanoids, tannins, triterpenes and phytosterols, resin.

Pre formulation studies

a)Incompatibility study

Fourier Transform Infrared Spectroscopy

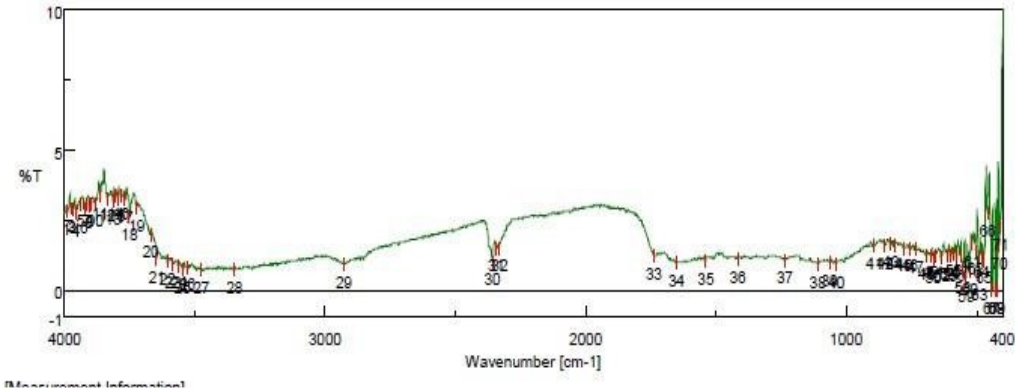
FTIR spectra for the ethanolic extracts of *Citrus sinensis* and *Punica granatum* extract(drug alone), its combination (drug- drug interaction) and extracts with excipients (drug-polymer/excipients interaction) were analysed in the present study. FTIR spectroscopy was utilized to characterize and identify compounds or functional groups (chemical bonds) in the plant extract mixture. The analysis revealed no physical incompatibilities between the drug and other components, including drug-polymer and drug-excipient interactions..



Graph no:1Interpretation of Fourier transform InfraRed(FTIR)Spectroscopy of (*Citrus sinensis extract*)

Tableno:5 IR interpretation of *Citrus sinensis extract*

Functional Group	Characteristic peaks(cm^{-1})	Observed peak(cm^{-1})
C-Cstretching	1200-800	1012.45
C-Ostretching	1260-1000	1163.83
C=Ostretching	1870-1540	1541.81
O-H stretching	2500-3300	3063.37

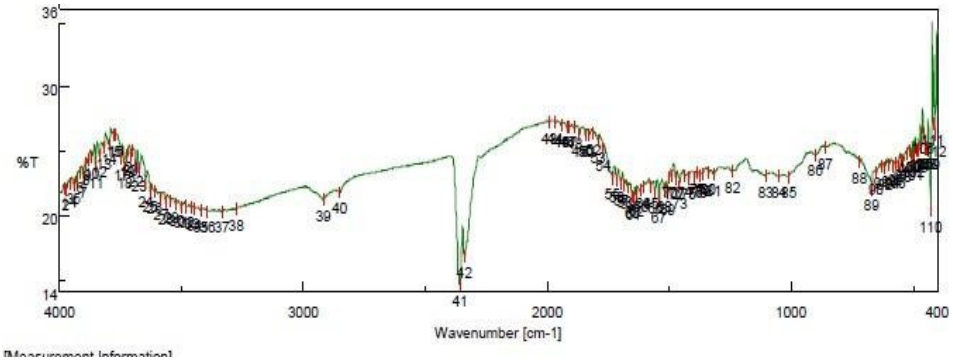


Graph no:2 Interpretation of Fourier transform Infrared (FTIR)Spectroscopy (*Punica granatum extract)*

Table.no:6 IR interpretation of *Punica granatum extract*

Functional Group	Characteristic peaks(cm^{-1})	Observed peak(cm^{-1})
C-Cstretching	1200-800	1038.48
C-Ostretching	1260-1000	1237.11
C=Ostretching	1870-1540	1652.7

O-H stretching	2500-3300	2930.31



Graphno:3ComparisonofPeakof*Citrus sinensis* and *Punica granatum* with Physical mixture

Tableno:7 IR interpretation of *Citrus sinensis* and *Punica granatum extract*

Functional Group	Characteristic peaks(cm^{-1})	Observed peak(cm^{-1})
C-Cstretching	1200-800	899.63
C-Ostretching	1260-1000	1242.9
C=Ostretching	1870-1540	1541.81
O-Hstretching	2500-3300	2850.27

Formulation of herbal nail lacquer of fruit peel extract of citrus *sinensis* and *punica granatum*

Fig no: 1 Fruit peel extracts **Fig no: 2 Preparation of nail lcquer** **Fig no: 3 Optimized formulation**

Physico- chemical evaluation of herbal nail lacquer formulations:

The results of physical parameters for formulation of nail lacquer like Visual appearance, pH, smoothness, gloss, drying time.

Table no: 8 Data showing physico-chemical attributes of herbal nail lacquer

Formulation code	Appearance	PH	Drying time(sec)	Smooth ness	Gloss	Water resistance	Film thickness
F1	+++	5.40±0 .06	80	No gloss and good smooth	+++	+++	0.065
F2	++	5.68±0 .01	78	Less gloss and good smooth	++	+++	0.078
F3	+++	5.62±0 .04	78	Gloss and smooth	+++	+++	0.095
F4	**+++**	**5.92.2 ±0.01**	**70**	**Gloss and smooth**	**+++**	**+++**	**0.14**

Results are expressed as mean ± SD, with qualitative assessments denoted as "++" for fair and "+++" for good.

All the prepare nail lacquer showed red colour due to the presence of Beetroot colouring agent. On the glass plate, it was discovered that the nail lacquer spread and formed a homogeneous, smooth film. The reduced concentration of polymer allowed for good smoothness in all formulations.

The F4 formulation was found to have the best glossiness out of all of the formulations. It was determined that glossiness was necessary to give the patient a cosmetically pleasing nail lacquer.

The drying rate increases from 70 to 80 seconds as the polymer concentration rises from F1 to F4 (Table 8). Because Formulation F4 contains a higher concentration of polymer, it dries faster than other formulations. This is suitable for people who want to keep their nails wet with nail lacquer for a shorter period of time. The characteristics of the solvent's volatility, and hence the drying period, have a significant impact on the application and cohesiveness of nail covering. The drying time increases as the polymer content rises.

After drying, there were differences in all preparations' thicknesses, ranging from 0.065 to 0.14 mm. The results that were observed are shown in Table 8. It was discovered that the lacquer's thickness was consistent across all formulations. Due to a higher concentration of polymer and plasticizer, the thickness of the F4 formulation exhibits exceptional strength, increased flexibility, and resistance to water. The layer thickness observations agreed with the benefits of thickness as described by a review of the film literature. In this case, the F4 formulation is more water resistant and weighs less overall. The information was referenced in Table 11. The F4 preparation exhibited no cloudiness, burning, or mass variation throughout the water's presence. It was discovered that the preparation's resistivity to water increased as the concentration of plasticizer and polymer increased.

Evaluation of formulated nail lacquer combination of Citrus *sinensis* and *Punica granatum* for antifungal activity

The fruit peel extracts were tested for antifungal activity against Candida albicans at a 5% concentration. Their potential was determined by measuring the zone of inhibition, indicating the extent of fungal growth inhibition. The results of anti-fungal activities are presented in Table no 9

Table no: 9 Result showing anti-fungal activity by agar well diffusion method

Diameter Zone Of Inhibition (mm)										**Fungal organism**
Ketoconazole(2 %)- standard	**Orange peel extract(5%)**			**Pomegranate peel extract (5%)**			**Fruit peel as Nail lacquer (5%)**			
10 µl	15 µl	20 µl	**25µl**	15 µl	20 µl	**25µl**	15 µl	20 µl	**25µl**	

14mm	12mm	14mm	**16mm**	14mm	16mm	**18mm**	6mm	8mm	**13mm**	*Candida albicans*

The antifungal activities of the extracts increased linearly with increase in concentration of extracts. The growth inhibition zone was measured as 16mm in 25µl and 18mm in 25µl of Orange peel extract and Pomegranate peel extract respectively

The growth inhibition zone was measured as 13mm in 25µl of both *orange peel and Pomegranate peel* extract as nail lacquer. The zone of inhibition was compared with standard Ketoconazole (2%) solution and it is measured as 14mm in 25µl.

The results show that the nail lacquer of fruit peel extract of orange peel and Pomegranate were found to be effective against *Candida albicans.* Result interpreted as per agar well diffusion method (20 and above: susceptible, 15-19mm: intermediate, less than 14mm: resistant)

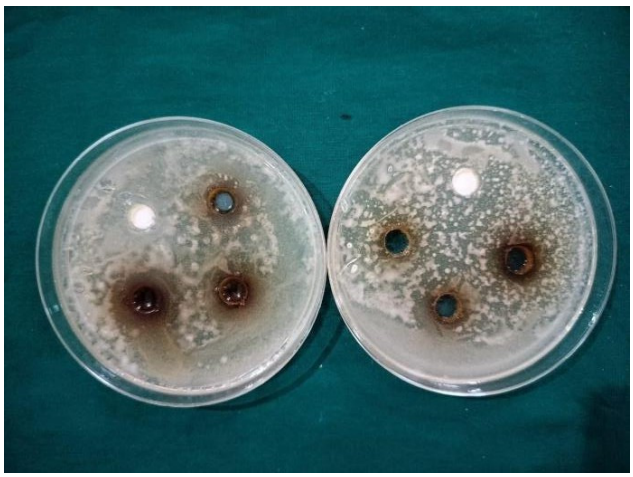


Fig no: 4 : 25µl(std, nail lacquer and extracts)

STABILITY STUDIES:

Optimized formulation was evaluated for its pH, appearance, gloss, drying time and smoothness. All the parameters were found tobe within therange even after 30 daysof study. So the optimized formulation was found to be thermostable. The results of the stability studies shown in Table no 10

Table no: 10. Table no:14: Results of stability studies after 30 days

Formulation code	Appearance	PH	Drying time	Smoothness	Film thickness	Gloss	Water resistence
F3	+++	5.90 ±0.06	72	Smooth and gloss	0.12	+++	+++

Results are expressed as mean ± SD, and the effectiveness is rated as "+++" for good outcomes.

After stability studies of the shampoo, evaluated for the parameters like Appearance, gloss, pH, drying time, water resistance, smoothness which doesn't show any prominent changes when compared to the formulation which kept at normal conditions.

CONCLUSION:

The present study aimed at evaluation of antifungal activity of *Pomegranate and Orange peel* extracts and its formulation. Extraction of both fruit peels were done by maceration method. Phytochemical studies showed presence of alkaloid, glycosides, saponin, flavonoids and carbohydrate in both fruit peel extracts. Study for effects of the *Pomegranate and Orange peel* extracts showed anti-fungal activity against *Candida albicans.*

Nail lacquer formulations containing ethanolic extracts of pomegranate and orange peel were successfully prepared using methyl cellulose and dibutyl phthalate. The formulations demonstrated satisfactory physicochemical properties and stable performance in stability studies. Study for effects of the formulated nail lacquer on *Candida albicans* showed that promoted antifungal activity. This is the first report on scientific evaluation of *Pomegranate and Orange peel* extracts and its nail lacquer formulation for anti-fungal activity. Thus, our study reveals that poly herbal formulation of *fruit peel* extract to be good anti-fungal, their ethanolic extracts may be formulated as nail lacquer with satisfactory physico-chemical parameters, however more studies on stabilizing the formulation for phytochemical composition needs to be done to improve its stability. This research project focused on the development of a medicated antifungal nail lacquer specifically designed to combat Onychomycosis. The nail plate, a complex structure composed of keratin fibers, acts as a hydrogel membrane, posing a significant challenge to drug delivery. Various microbial infections, including those caused by dermatophytes, can infect the nail plate, leading to a range of diseases, including onychomycosis, psoriasis, and leuconychia. Traditional formulations, such as solutions, creams, and lotions, have several drawbacks, including poor retention, ease of removal, and limited efficacy. One key advantage of medicated nail lacquers is their ability to form a film on the nail, enabling sustained release of the active ingredient over time.

CONFLICT OF INTEREST:

The authors have no conflicts of interest regarding this investigation**.**

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