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FORMULATION AND EVALUATION OF HERBAL ORALLY DISINTEGRATING FILM FOR ORAL CANDIDIASIS

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ABSTRACT

Oral candidiasis is a fungal infection caused by the overgrowth of Candida species, typically Candida albicans, in the mouth and throat. This study focuses on the formulation and evaluation of a herbal orally disintegrating film containing Liquorice and Oregano, demonstrating its potential as a convenient and effective therapeutic option. The formulations (F1-F6) share a consistent use of HPMC K100 as the polymer, propylene glycol as the plasticizer, stevia as the sweetener, and distilled water as the solvent. However, they differ in their active ingredients and their quantities. The formulated films exhibited desirable physicochemical properties such as uniformity in thickness, weight variation, and mechanical strength and disintegration time, indicating their suitability for oral administration. Furthermore, in vitro drug release studies revealed the release of active constituents from the films, suggesting prolonged therapeutic efficacy and enhanced bioavailability. This antimicrobial activity is due to presence of bioactive compounds glycyrrhizin, carvacrol and thymol, have been reported to possess antifungal properties against Oral candida. The developed formulations offer several advantages including rapid disintegrating, excellent physical characteristics, bio adhesive properties, and potent antifungal activity, thereby holding great promise for clinical translation and future therapeutic applications.

KEYWORDS: Orally Disintegrating Film, Oregano, Liquorice, Oral Candidiasis, Fast Dissolving Film.

INTRODUCTION

The oral route is the most common route for drug administration. It is the most preferred route, due to its advantages, such as non-invasiveness, patient compliance and convenience of drug administration. Orally Disintegrating Films offers an elegant route for systemic drug delivery. The improved systemic bioavailability results from bypassing first pass effect and better permeability due to a well-supplied vascular and lymphatic drainage. Also, large surface area of absorption, easy ingestion & swallowing, pain avoidance makes the oral mucosa a very attractive and selective site for systemic drug delivery.[1] This study focuses on the formulation and evaluation of a herbal orally disintegrating film designed for the treatment of oral candidiasis, demonstrating its potential as a convenient and effective therapeutic option.

Orally disintegrating film

Orally disintegrating films are thin, flexible films that dissolve rapidly in the mouth without the need for water. They offer a convenient and patient-friendly alternative to traditional oral dosage forms such as tablets and capsules, particularly for individuals who have difficulty swallowing or are unable to take medication with water. ODFs are typically composed of a water-soluble polymer matrix that encapsulates the Active Pharmaceutical Ingredient along with other excipients such as plasticizers, flavoring agents, and sweeteners.[2] These films are manufactured using various methods like solvent casting, hot melt extrusion, and spray drying.

Oral film get dissolve while make in contact with saliva, they do not need to chew or drink water. This makes ODF ideally suitable for paediatric as well as geriatric patients who faces difficulties to swallow Tablet or Capsule, Diarrhoea, Coughing issue, Bedridden and Emetic patients. This report aims to provide a comprehensive overview of orally disintegrating films, covering their formulation, mechanism of action, advantages over conventional dosage forms, regulatory landscape, market trends, and emerging applications.[3]

Oral candidiasis

Oral candidiasis, commonly known as oral thrush, is a fungal infection caused by the overgrowth of Candida species, typically Candida albicans, in the mouth and throat. It often appears as white or creamy patches on the tongue, inner cheeks, roof of the mouth, and throat. Oral candidiasis is an infection of the oral cavity by *Candida albicans,* first described in 1838 by pediatrician Francois Veilleux. The condition is generally obtained

secondary to immune suppression, which can be local or systemic, including extremes of age (newborns and elderly), immune compromising diseases such as HIV/AIDS, and chronic systemic steroid and antibiotic use. Oral candidiasis can occur in immune competent or immunocompromised patients but is more common in immunocompromised hosts. More than 90% of patients with HIV develop oral candidiasis at some point during the duration of the disease.[4] Candidiasis can appear in the oral cavity as white or erythematous lesions.

Oregano

Oregano is light green leaves are used either dry or fresh as a culinary seasoning, and its use has elicited such sensory responses as pungent, pleasantly bitter, herbaceous and aromatic to name a few. Origanum vulgare it has strong antiseptic and antimicrobial activity due to the presence of carvacrol and thymol, both phenolic compounds which directly inhibit germination and hyphal formation in Candida. In human beings, the antifungal activities of O. vulgare have been studied against the Candida isolated from sources of various systemic conditions. Oreganum vulgare was chosen to characterize its antifungal effects on oral isolates of Candida from a denture wearer with CADS.[5]

Liquorice

Liquorice is derived from the roots of the Glycyrrhiza glabra plant, is a popular herb with a distinct sweet flavour used in culinary and medicinal practices. Its active compound, glycyrrhizin, gives it a characteristic taste and potential health benefits. Commonly utilized in confectionery, Liquorice is also employed in traditional medicine for its anti-inflammatory, antimicrobial, and expectorant properties. It's often found in herbal teas, candies, and supplements. Liquorice, specifically its bioactive components like glycyrrhizin, glabridin, licochalcone A, and others, has shown potential beneficial effects in managing oral diseases, including oral candidiasis. Research indicates that liquorice extracts have demonstrated antifungal effects against Candida albicans, the most common form of candida responsible for oral thrush.[6]

Mechanisms of Action of ODF against Oral Candidiasis

The mechanism of action of Orally Disintegrating Films involves their unique design and composition, which allows for rapid disintegration and drug release in the oral cavity. ODFs are thin, flexible films that dissolve or disintegrate within seconds when placed on the tongue or oral mucosa, providing a quick release of the drug for absorption.[7] The key aspects of the MOA of ODFs include:

1. **Rapid disintegration:** ODFs are designed to disintegrate quickly upon contact with saliva, allowing the film to hydrate, adhere to the oral mucosa, and release the medication for absorption.
2. **Mucosal absorption:** ODFs facilitate drug absorption through the oral mucosa, providing an alternative route for drug delivery that bypasses the gastrointestinal tract and first-pass metabolism.
3. **Film composition:** ODFs are composed of film-forming polymers like hydroxypropyl methylcellulose (HPMC), plasticizers, sweetening agents, flavouring agents, and other excipients that contribute to film's mechanical properties, disintegration characteristics, and drug release profile.

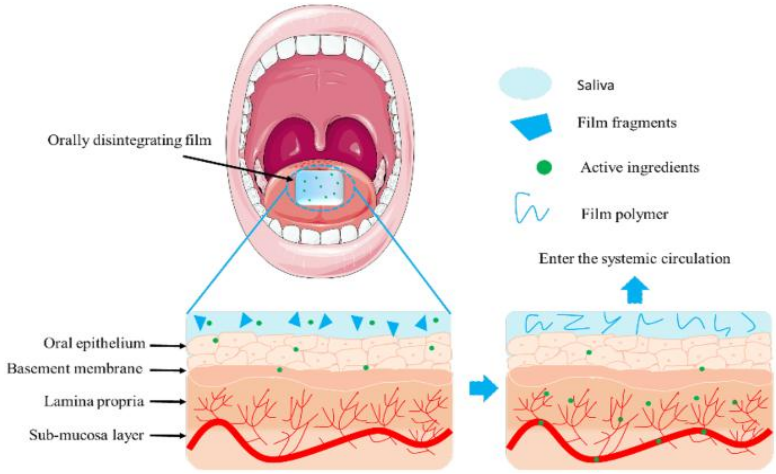


Fig. 1: Mechanism of Action of ODF.

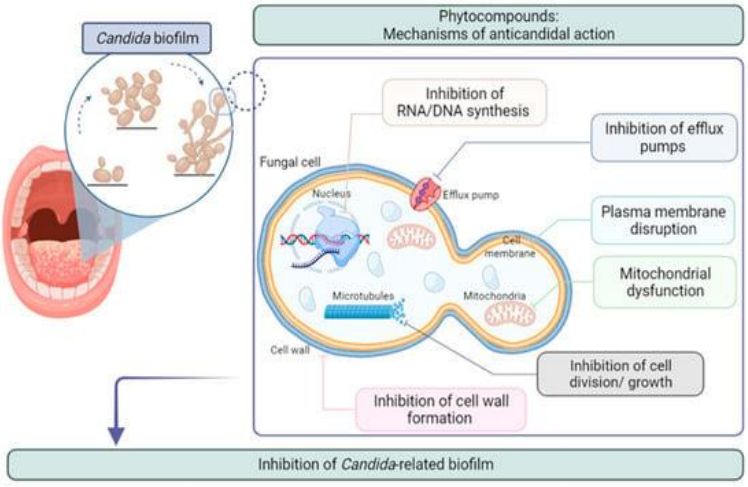


Fig. 2: Mechanism of action of oral candidiasis.

The mode of action of an orally disintegrating film against oral candidiasis typically involves the delivery of antifungal agents directly to the affected oral mucosa, where the Candida

overgrowth occurs. ODFs dissolves rapidly upon contact with saliva, releasing the active ingredients.

Antifungal agents work by disrupting the fungal cell membrane or inhibiting fungal enzyme activity, ultimately leading to the death of the Candida species causing the infection. The ODF formulation enhances drug bioavailability and ensures targeted delivery to the affected area, maximizing therapeutic efficacy while minimizing systemic side effects. Additionally, the rapid disintegration of the film allows for convenient administration, making it suitable for patients with swallowing difficulties or those who prefer a non-liquid dosage form.[8] Overall, ODFs offer a promising approach for the effective management of oral candidiasis.

MATERIALS AND METHODS

Ingredients used

Oregano Essential Oil was obtained from Devika Natural Oils Brand [DVNO] from JioMart shopping website. Liquorice roots were obtained from the market. HPMC K100 (Research Laboratory), Propylene Glycol (Molychem Laboratories), Stevia (Clever Low Calorie Antidiabetic Sugar Crystals), Methyl Paraben (BRM Chemicals), Ethanol (Fine Chemicals and Solvents), Toluene, Ethyl Acetate, Glacial Acetic Acid, Anisaldehyde-Sulphuric Acid, Dilute Hydrochloric Acid, Hager's Reagent, Dragendorff Reagent, Mayers Reagent, $FeCl_3$ solution, Acetic Acid, Concentrated Sulfuric Acid, Potassium Dihydrogen Orthophosphate, Anhydrous, Calcium Chloride, Sodium Hydroxide Pallets and Distilled Water.

Equipment's used

Hot air oven, Magnetic stirrer, Sonicator, Microscope, UV visible Spectrophotometer, pH meter, Incubator, Desiccator, Weighing Balance, Fourier Transform Infrared Spectrometer, UV Chamber and Disintegration Apparatus.

METHODOLOGY

Preparation of extract

The dried roots of Liquorice were collected from the market. The dried roots are grinded in mixer into fine powders. The powder is sieved to get uniform powder. The powder was weighed 10grams and used for extraction. In case of Liquorice roots, the solvent used was ethanol and water (30:70 v/v). 30ml of Ethanol was mixed with 70ml distilled water to form solvent for extraction. For about 60 minutes, the root extract was immersed in this extraction solvent for Maceration.[9] The residue of maceration extract and filtrate of maceration were

separated and being kept for further screening. The hydro alcoholic extract was used for screening of Phytochemical tests and TLC analysis. The extract was concentrated at room temperature. The extract was boiled to evaporate the hydro alcoholic content of the extract. After evaporating the solid extract Glycyrrhizin was collected and sieved. It contains 7% of sweet component Glycyrrhizin.[10]

Formulation of orally disintegrating film

The solvent casting method is used for the preparation of fast dissolving strip formulation. The oral fast dissolving strips were prepared by taking ingredients in different concentration of HPMC K100 and the drug (Liquorice extract and Oregano oil). HPMC K100 was dispersed in distilled water and Methyl Paraben followed by continuous stirring up to 30 minutes on magnetic stirrer and kept for 15 min to remove all the air bubbles entrapped inside polymeric solution. To this plasticizer that is propylene glycol was added. Solution of Stevia was prepared in separate beaker dissolving specific amount of Stevia sugar crystals in distilled water. Both the solutions were mixed together followed by mixing Liquorice extract and Oregano Oil keeping the solution on magnetic stirrer. The mixture was kept on Sonicator for 15 mins followed by standing the mixture for 15-30 min to let the foams settle down. The resultant mixture was poured in petri dish. The petri dishes were kept in oven for casting of film at 40 degree Celsius temperature.[11] After drying the film was carefully taken from the petri dish, checked for flaws, and trimmed to the desired size (2 x 2 cm2) per strip. The resultant films were stored into aluminium foil then zip lock bag.

Ingredients	Uses	F1	F2	F3	F4	F5	F6
HPMC K100	Polymer	0.8g	1g	0.8g	1g	0.8g	1g
Liquorice Ext.	Drug (API)	0.8g	0.8g	-	-	0.8g	0.8g
Oregano Oil	Drug (API)	-	-	0.5ml	0.5ml	0.5ml	0.5ml
Propylene Glycol	Plasticizer	1ml	1ml	1ml	1ml	1ml	1ml
Methyl Paraben	Preservative	0.02g	0.02g	0.02g	0.02g	0.02g	0.02g
Stevia	Sweetener	0.8g	0.8g	0.8g	0.8g	0.8g	0.8g
Distilled Water	Solvent	17ml	17ml	17ml	17ml	17ml	17ml

Tab. 1: Formulation table.

Analysis of liquorice Extract and Oregano oil

1. Calibration curve of liquorice extract

10mg of dried Liquorice extract (glycyrrhizin) was dissolved in 10 ml of distilled water and volume was made up to 100ml in a volumetric flask. And then pipette out this stock solution to prepared the serial dilution, solutions with concentration 10µg/ml, 20µg/ml, 30µg/ml,

40µg/ml and 50µg/ml were prepared as shown in table and the absorbance of each solutions was measured on a Shimadzu Double Beam Spectrophotometer at 254nm. The wavelength maxima of Glycyrrhizin is 254nm.[12]

Stock Solution and Dilutions preparation

10mg Glycyrrhizin ⟶ 100ml Distilled Water (0.1mg/ml i.e. 100µg/ml)

1ml Stock Solution ⟶ 10ml Distilled Water (10µg/ml)

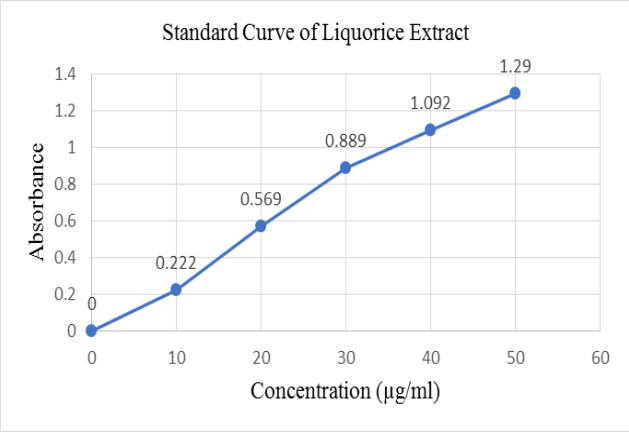
2ml Stock Solution ⟶ 10ml Distilled Water (20µg/ml)

3ml Stock Solution ⟶ 10ml Distilled Water (30µg/ml)

4ml Stock Solution ⟶ 10ml Distilled Water (40µg/ml)

Concentration (µg/ml)	Absorbance
10	0.222
20	0.569
30	0.889
40	1.092
50	1.290

Tab. 2: Absorbance reading.



Grp. 1: Absorbance vs Concentration.

Equation: y = 0.0266x + 0.0147

Slope: 0.0266, **y intercept:** 0.0147

2. Thin layer chromatography of liquorice extract

Firstly, the TLC plate is prepared by cutting it to the desired size and marking a baseline about 1 cm from the bottom of the plate. Next, the sample that is alcoholic extract of

Liquorice is applied as small spots along the baseline using a capillary tube. These spots are then allowed to dry completely.[13]

Mobile phase preparation: Toluene: Ethyl acetate: Glacial acetic acid 12.5ml: 7.5ml: 0.5ml
The prepared Mobile Phase was saturated in the chamber. The development of the TLC plate begins by placing it in a developing chamber with a small amount the mobile phase. This process separates the components of the sample based on their differential affinity for the stationary phase (adsorbent) and the mobile phase (solvent). Once the solvent front reaches near the top of the plate, the plate is removed from the chamber and allowed to dry.

Spraying agent: Anisaldehyde –sulphuric acid[14]

Fig. 3: TLC Plates.

Solvent front distance: 4.6 cm
Distance travelled by solute (glycyrrhizin) spot: 2.4 cm

$$\text{Rf (Retention Factor) value} = \frac{\text{Distance travelled by Solute}}{\text{Distance travelled by Solvent}}$$

Rf value = 2.4/4.6 = 0.52
Retention Factor value of Glycyrrhizin is found to be 0.52.

3. Phytochemical tests

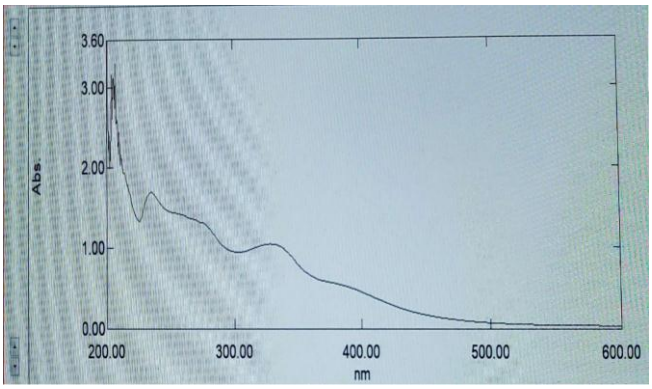
Glycyrrhiza glabra, possesses various phytochemical compounds, including glycyrrhizin, flavonoids, saponins, and coumarins. Phytochemical tests involve several methods to identify and quantify these compounds. The extracts were tested for the presence of various active chemical constituents namely alkaloids, flavonoids, glycosides, tannins, saponins, steroids.[15]
The results of the phytochemical study were given in table.

Phytochemical tests	Observations	Inferences
Alkaloids Dried Extract + dil. HCl then filter 1. Hager's Test Filtrate + Hager's Reagent 2. Dragendorff Test Filtrate + Mayers Reagent	Yellow ppt Orange brown ppt	Alkaloids Present
Saponin glycosides Foam Test : Shake the drug extract vigorously with water	Persistent stable foam observed	Saponin Glycosides Present
Tannins 1. Extract + $FeCl_3$ solution 2. Extract + Acetic Acid	Blue black colour Red colour	Tannins Present
Flavonoids Extract + dil. HCl/H_2SO_4	Reddish Orange Colour	Flavonoids Present
Steroids Salkowski Reaction Extract + 2ml Chloroform + 2ml conc. H_2SO_4. Shake well.	Chloroform layer appears red and Acid layer show fluorescence	Steroids Present

Tab. 3: Phytochemical tests of liquorice.

4. UV Spectrum of liquorice extract

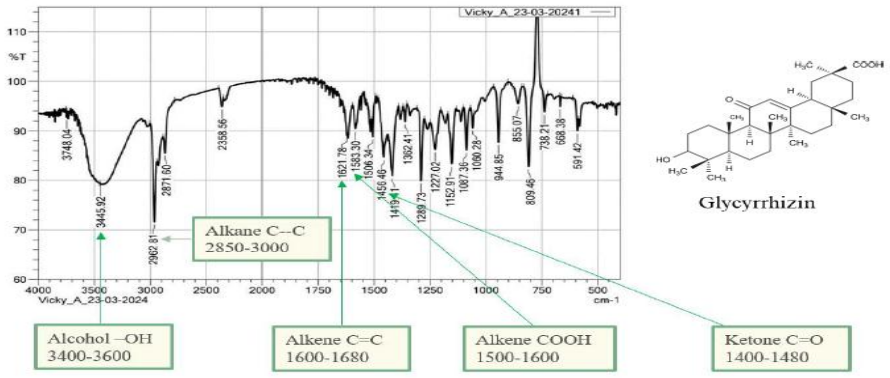
UV spectrum is basically graph of wavelength vs absorbance. It is generally used to determine the λ_{max} (Wavelength Maximum) of compound. For obtaining the spectrum, the extract dilution of 10 µg/ml was prepared. 10mg of drug was dissolved in 100ml, from this solution 1ml of solution is pipette out and diluted to 10ml of distilled water 10 µg/ml concentration solution. This solution was transferred to cuvette and spectrum was observed from 200 to 400nm wavelength. The maxima wavelength (λ_{max}) was found to be 254nm. i.e. λ_{max} of active compound Glycerrhizin.[16]



Grp. 2: UV Spectrum of liquorice extract.

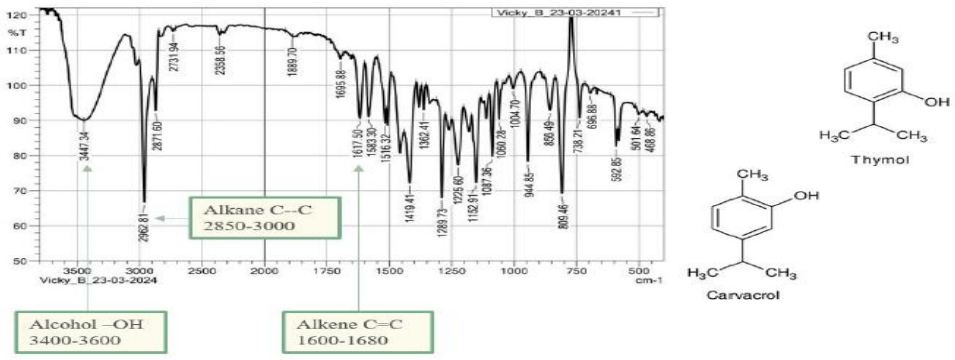
5. IR Spectrum of liquorice

FTIR (Fourier Transform Infrared Spectroscopy) is an analytical instrument which provides molecular structure and functional group of the compound by analyzing Infrared Light.[17] We have done FTIR of Oregano Oil and Liquorice Extract from Dr. L.H. Hiranandani College of Pharmacy, Ullasnagar. We provided them with the test sample and following are the result graphs obtained by IR Spectroscopy.



Grp. 3: IR Spectrum of liquorice extract.

6. IR Spectrum of Oregano Oil



Grp. 4: IR Spectrum of oregano oil.

Evaluation tests

1. Morphological properties

Visual observations were made of the morphological characteristics, such as the homogeneous nature of the films, colour, transparency, and surface texture. Orally dissolving films are thin, flexible films designed to disintegrate rapidly upon contact with saliva, allowing for quick and easy administration of medication without the need for water. They possess controlled porosity, hydrophilicity, and flexibility, ensuring quick drug delivery and

patient comfort. ODFs vary in appearance and surface texture, optimizing adhesion and handling during administration.[18]

Fig. 4: Orally disintegrating films.

2. Weight variation

The weight variation of orally dissolving films (ODFs) refers to the consistency in weight among individual film units within a batch. It is a critical parameter for ensuring uniform dosage delivery. A specified number of film units are randomly selected and weighed individually using a calibrated balance. The weight variation was calculated by adding all of the formulation weights and calculating the average weight, then the individual weights were subtracted to it to calculate the weight variations.[19] The weights are recorded, and statistical analysis is performed to determine if the variation among the weights falls within acceptable limits.

3. Moisture content

The moisture content of orally dissolving films (ODFs) is a critical parameter that affects their stability, integrity, and performance. The determination of moisture content involves accurately measuring the amount of water present in the film matrix. Moisture content of the oral film was evaluated by placing samples in a desiccator with anhydrous calcium chloride for 24 hours. The desiccator seal and calcium chloride effectiveness were monitored. Samples were then removed, and their weight was measured before and after to assess moisture content. The percentage moisture uptake calculated by mentioned formula.[20]

% moisture content = (intial weight – final weight) / intial weight) x 100

4. Surface pH Determination

pH of orally dissolving films (ODFs) is an important parameter that can influence drug stability, solubility, and patient comfort upon administration. The film kept in a Petri dish was

moistened with 5 ml of distilled water and kept for a few minutes. The pH was noted after bringing the electrode of the pH meter in contact with the surface of the formulation and allowing equilibration for 1 min.[21] The surface pH was calculated by dissolving the films on 10ml distilled water and the test was done by calculating the pH on a calibrated digital pH meter at room temperature.

5. Disintegration time

Preparation of Phosphate Buffer with pH 6.8

13.86g of Potassium Dihydrogen Orthophosphate was weighed accurately then transferred to 1000ml volumetric flask. Distilled water was added to the flask. The volume was made up to 1000ml with distilled water. The pH of the solution was checked with the calibrated pH meter. The pH was adjusted to 6.8 by adding drops of Sodium Hydroxide Solution.[22]

The disintegration time of orally dissolving films refers to the duration it takes for the film to completely disintegrate and dissolve when placed in the oral cavity. The Disintegration Time was recorded in Phosphate Buffer of pH 6.8. Disintegration time of all the formulations were calculated on a disintegration apparatus. For creating a mouth like environment, we used a 6.8 pH Phosphate buffer which is the same to the pH of the oral cavity. For the study, film as per the dimension (2×2cm) required for dose delivery was placed in a basket containing 900 mL distilled water.[23] Time required for the film to break and disintegrate was noted as in-vitro disintegration time.

6. Folding endurance test

Folding endurance of a film refers to its ability to withstand repeated folding without cracking or breaking, which is indicative of its mechanical strength and flexibility. The folding endurance of a film is a measure of its mechanical durability and flexibility, crucial for handling, packaging, and administration. The film's folding endurance was assessed by repetitively folding a small strip (2x2sq.cm) without causing it to break. The folding endurance value is determined by the number of times the film can be folded at the same spot without fracturing.[24]

7. Drug content uniformity

Drug content uniformity is a critical quality attribute in pharmaceutical manufacturing, ensuring that each dosage unit of a drug product contains the intended amount of the active pharmaceutical ingredient (API) in a consistent and uniform manner. Five films of 2*2 cm^2

area were taken and added to a beaker containing 100 ml of Phosphate Buffer. The film was dissolved in the solvent completely. The solution was then filtered and analysed for drug content with proper dilution at 254 nm on UV-Visible Spectrophotometer.[25]

8. Anti-fungal activity

Antimicrobial activity testing is a crucial step in evaluating the effectiveness of oral film in treatment of Oral Candidiasis. Evaluating the antifungal activity of film involves several steps, from preparation of the film to in vitro and in vivo testing. The steps involved in the agar disc diffusion method are: preparation of agar plates, preparation of fungal suspension, inoculation of agar plates, application of antifungal film discs, incubation, measurement of zone of inhibition, controls, and recording and analysis.[26]

Antifungal activity of the film was assessed from **Medicayer Pathology Laboratory Private Limited** situated at Dombivali (E). Oral Film sample was submitted to the laboratory for antifungal activity against *Candida Albicans*.

Method: Agar Diffusion Disk Method

Agar: Muller-Hinton Agar

Incubation: 35-37°C for 24 hours

The test sample shows potential antifungal activity against *Candida Albicans*. It inhibit the growth of *Candida species.*

Zone of Inhibition measured is 22mm

9. Stability studies

Our comprehensive 30-day stability assessment of the oral film yielded promising results. We observed no microbial growth, minimal degradation, consistent coloration, and no changes in organoleptic properties. Notably, the film remained stable at room temperature, demonstrating its practical viability and resilience against environmental influences. These findings highlight our dedication to maintaining formulation quality and adhering to regulatory standards, ensuring the reliability and effectiveness of these films for future applications.[27]

Our 30-day stability study on the oral film revealed

- No microbial growth
- Minimal degradation
- Consistent colour

- No organoleptic change

Notably, it remained stable at room temperature, demonstrating practical applicability and resilience against environmental factors. These findings underscore our commitment to formulation quality and regulatory compliance, ensuring reliability for future use.

RESULTS

1. Morphological characteristics

Parameter	Result
Homogeneity	Homogeneous
Transparency	Transparent
Color	Light Yellow
Surface	Smooth
Tackiness	Non-tacky
Size	2 * 2 cm

Tab. 4: Morphological properties.

2. Weight variation

Formulation	Individual wt. (g)	Avg. Weight (g)	Weight variation (Individual – Avg. weight)
F1	0.023	0.024	-0.001
F2	0.027	0.024	0.003
F3	0.022	0.024	0.002
F4	0.027	0.024	0.003
F5	0.023	0.024	-0.001
F6	0.024	0.024	0.00

Tab. 5: Weight variation of films.

3. pH determination

Formulation	pH
F1	6.72
F2	6.70
F3	6.74
F4	6.41
F5	6.75
F6	6.79

Tab. 6: pH of films.

4. Moisture content

Formulation	Weight before desiccation (g)	Weight after desiccation (g)	Difference (g)	%Moisture Content
F1	0.023	0.020	0.003	13.04
F2	0.027	0.025	0.002	7.40
F3	0.022	0.021	0.001	3.67

F4	0.027	0.027	0.000	0
F5	0.023	0.021	0.002	8.69
F6	0.024	0.024	0.000	0

Tab. 7: Moisture content results.

5. Disintegration time

Formulation	Disintegration time (seconds)
F1	59
F2	70
F3	55
F4	78
F5	64
F6	79

Tab. 8: Disintegration time in seconds.

6. Drug content uniformity

Formulation	Absorbance at 254nm	Drug content
1	0.212	95.49
2	0.209	94.90
3	0.174	78.37
4	0.223	102.81
5	0.191	86.03

Tab. 9: Percentage drug content.

CONCLUSION

The study successfully demonstrated the potential of utilizing oregano and liquorice extracts in the formulation of orally disintegrating films for the treatment of oral candidiasis. Firstly, the formulated films exhibited desirable physicochemical properties such as uniformity in thickness, weight variation, and mechanical strength and disintegration time, indicating their suitability for oral administration. Additionally, the films demonstrated that quick symptom relief through rapid disintegration in the oral cavity ensuring patient compliance and ease of administration, particularly beneficial for paediatric as well as geriatric patients who faces difficulties to swallow Tablet or Capsule, Diarrhoea, Coughing issue, Bedridden and Emetic patients.

Furthermore, in vitro drug release studies revealed sustained release of active constituents from the films, suggesting prolonged therapeutic efficacy and enhanced bioavailability. This sustained release profile is advantageous for the treatment of oral candidiasis, as it ensures

prolonged contact of the active ingredients with the affected mucosal surfaces, maximizing therapeutic outcomes.

The formulations (F1-F6) share a consistent use of HPMC K100 as the polymer, propylene glycol as the plasticizer, stevia as the sweetener, and distilled water as the solvent. However, they differ in their active pharmaceutical ingredients (APIs) and their quantities. F1 and F2 contain liquorice extract as the API, with F2 having a higher quantity of HPMC K100. F3 and F4 utilize oregano oil as the API, with F4 containing more HPMC K100. F5 and F6 combine liquorice extract and oregano oil as APIs, with both formulations having the same quantities of all ingredients.

The antimicrobial activity of Formulations 5 and 6 against Candida species was notable, suggesting their potential as alternative treatments for oral candidiasis. This antimicrobial efficacy can be attributed to the presence of bioactive compounds in Liquorice's like glycyrrhizin, glabridin, and licochalcone and Oregano (Origanum vulgare), Which have been reported to possess antifungal properties against Oral candida. Overall, Formulation 5 of the herbal orally disintegrating films offer a promising approach for the treatment of oral candidiasis, providing rapid disintegration, excellent physical characteristics, bio adhesive properties, and significant antimicrobial activity.

In conclusion, the study underscores the feasibility and efficacy of utilizing oregano and liquorice extracts in the formulation of herbal orally disintegrating films for the treatment of oral candidiasis. The developed formulations offer several advantages including rapid disintegration, sustained drug release, and potent antifungal activity, thereby holding great promise for clinical translation and future therapeutic applications in the management of oral candidiasis. Further clinical studies are warranted to validate the safety, efficacy, and long-term benefits of these herbal formulations in human subjects.

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Authors contribution

All authors have contributed equally to the research. This includes data collection, literature review, methodology design, laboratory, data analysis and interpretation, supervision of the research project. All aspects of the research were conducted collaboratively and supported by all authors. Research manuscript was prepared and drafted by Vicky Chaurasiya under the guidance of Dr. Prashant Jagadhane.

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Conflict of interest

The authors declare no conflict of interest.

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