Polyherbal Mouth Dissolving Films for Oral Ulcer Therapy

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***Abstract*—Mouth ulcers, clinically known as recurrent aphthous stomatitis (RAS), affect nearly 20% of the global population and significantly impair quality of life. Conventional therapies, including corticosteroid gels and antiseptic rinses, suffer from poor bioadhesion, dose inaccuracies, and adverse effects. This study explores the development of a novel polyherbal mouth dissolving film (MDF) incorporating Careya arborea and Glycyrrhiza glabra extracts, leveraging their synergistic anti-inflammatory, antioxidant, antimicrobial, and wound-healing properties. MDFs were prepared using solvent casting and hot-melt extrusion techniques with HPMC E15 as the primary polymer and PEG 400 as plasticizer. Films were evaluated for thickness, folding endurance, tensile strength, surface pH, disintegration time, and drug release profile. Phytochemical screening confirmed the presence of flavonoids, tannins, and glycyrrhizin. In-vitro dissolution studies demonstrated rapid disintegration (<30 seconds) and >80% drug release within 10 minutes. Comparative analysis with conventional gels highlighted superior mucoadhesion, faster onset of action, and enhanced patient compliance. The polyherbal MDF provided site-specific protection, reduced ulcer diameter, and accelerated mucosal healing in simulated models. This work underscores the potential of herbal MDFs as patient-friendly, effective alternatives to conventional therapies, paving the way for clinical translation in oral ulcer management.**

***Index Terms*—Mouth dissolving films, Careya arborea, Glycyrrhiza glabra, recurrent aphthous stomatitis, herbal drug delivery, mucoadhesion.**

I. INTRODUCTION

A. The Oral Cavity – Environment

The oral cavity is the first anatomical segment of the digestive system and provides a complex environment for drug delivery. It is constantly bathed in saliva, which plays a dual role: acting as a solvent for disintegration of oral films while simultaneously contributing to rapid clearance of conventional formulations such as gels and rinses [1]. Daily salivary secretion ranges between 0.5–1.5 liters, and this continuous flow creates a "wash-out effect" that reduces residence time of topical agents [2].

The salivary pH, typically between 6.2–7.6, is another critical factor influencing drug stability. Herbal actives incorporated into mouth dissolving films (MDFs) must remain stable within this range to prevent premature degradation before reaching the ulcer site [3]. Furthermore, the oral cavity is subject to constant mechanical movements of the tongue, cheeks, and lips, which can dislodge weakly adherent dosage forms. This highlights the importance of mucoadhesion in MDF design, ensuring that the film remains localized long enough to deliver therapeutic agents effectively [4,5].

Beyond its mechanical and chemical environment, the oral cavity also provides unique advantages for drug delivery. The absence of the stratum corneum in oral mucosa enhances permeability compared to skin, enabling rapid absorption of actives. This makes the oral cavity particularly suitable for formulations requiring fast onset of action, such as analgesics and anti-inflammatory agents for ulcer management [6].

Table 1. Regional Anatomy and Relevance for Ulcer Therapy

Region	Type of Mucosa	Permeability	Relevance to MDF
Buccal (Cheeks) [1]	Non-keratinized	High	Optimal site for systemic absorption

Sublingual (Tongue)[2, 3]	Non-keratinized	Very High	Fastest absorption, but challenged by saliva flow
Gingival (Gums) [4]	Keratinized	Low	Painful ulcers persist longer due to slow penetration
Hard Palate (Roof) [5,6]	Keratinized	Very Low	Rarely used for drug delivery

B. The Oral Mucosa – Biological Target

The oral mucosa serves as the primary biological target for mouth dissolving films (MDFs). Unlike external skin, it lacks the protective stratum corneum, making it highly permeable to therapeutic agents [7]. Structurally, the mucosa comprises three layers: the epithelium, basement membrane, and lamina propria. The epithelium, particularly in non-keratinized regions such as the buccal and sublingual mucosa, is soft and highly permeable, providing an ideal site for MDF adhesion [8]. The basement membrane acts as a supportive interface, but in ulcerative conditions it is often damaged, exposing deeper tissues. The lamina propria, rich in collagen and capillaries, facilitates rapid drug absorption and localized healing [9].

Drug transport across the mucosa occurs via two major pathways:

- Paracellular route – diffusion between epithelial cells.
- Transcellular route – direct passage through cells.

Due to the high vascularization (~2.4 mL/min/cm²), drugs delivered via MDFs enter systemic circulation or inflamed tissue almost instantly, ensuring rapid onset of action [10]. This property is particularly advantageous for ulcer therapy, where immediate pain relief and accelerated healing are critical.

Regional differences in mucosal permeability influence therapeutic outcomes. Buccal mucosa offers high permeability and patient comfort, while sublingual mucosa provides the fastest absorption but is challenged by high saliva flow. Gingival and palatal mucosa, being keratinized, exhibit lower permeability and slower drug penetration [11]. These anatomical variations guide the selection of optimal sites for MDF placement.

C. Mouth Ulcers – Clinical Burden

Mouth ulcers, clinically referred to as recurrent aphthous stomatitis (RAS), are among the most common painful lesions of the oral mucosa, affecting approximately 20% of the global population [12]. These lesions are characterized by localized epithelial loss, exposing underlying nerve endings and resulting in pain, burning sensations, and difficulty in eating, speaking, and swallowing. The condition significantly impairs quality of life and nutritional intake, particularly when consuming acidic or spicy foods [13].

Figure 1 : Mouth Ulcer

The etiology of RAS is multifactorial and not fully understood. Contributing factors include psychological stress, nutritional deficiencies (vitamin B12, iron, folic acid), hormonal imbalance, immune dysregulation, microbial infections, trauma, and genetic predisposition [14]. Although self-limiting in most cases, the recurrent nature, pain intensity, and delayed healing necessitate effective therapeutic interventions [15].

Conventional therapies such as topical corticosteroids, antiseptic mouthwashes, antimicrobial gels, and analgesic preparations provide symptomatic relief but are associated with limitations. These include poor bioadhesion due to continuous salivary wash-out, dose inaccuracies in application, unpleasant taste, frequent dosing requirements, and adverse effects such as mucosal thinning or secondary fungal infections [16,17]. Long-term use of synthetic corticosteroids,

for instance, predisposes patients to oral candidiasis, further complicating management [18].
Recent systematic reviews emphasize the need for safer, patient-friendly alternatives that combine rapid onset of action with localized therapeutic effects [19]. Herbal formulations, particularly those incorporating anti-inflammatory and wound-healing agents, are increasingly recognized as promising candidates for ulcer management [20].

D. Limitations of Conventional Therapy
Conventional therapies for mouth ulcers include topical corticosteroids, antiseptic rinses, antimicrobial gels, and anesthetic preparations. While these agents provide symptomatic relief, their effectiveness is limited by several pharmacological and patient-related factors.
One major drawback is poor bioadhesion. Gels and rinses are rapidly cleared by continuous salivary flow, reducing contact time with the ulcer site and limiting therapeutic efficacy [21]. Dose inaccuracy is another challenge, as patients often struggle to apply the correct amount of gel to posterior oral regions [22]. Furthermore, the unpleasant taste of many formulations reduces compliance, particularly among pediatric and geriatric populations [23].
Long-term use of corticosteroids, the most common treatment, is associated with adverse effects such as mucosal thinning, delayed wound healing, and secondary fungal infections (oral candidiasis) [24]. Antiseptic rinses, while useful for microbial control, can cause burning sensations and alter taste perception [25]. Analgesic preparations, though effective for pain relief, offer only temporary benefit and do not accelerate healing [26].
These limitations collectively highlight the need for novel drug delivery systems that combine site-specific action, rapid onset, and improved patient compliance. Polyherbal mouth dissolving films (MDFs) represent a promising alternative, offering mucoadhesion, localized drug release, and reduced systemic side effects [27].

E. Innovation – Mouth Dissolving Films (MDFs)
Mouth dissolving films (MDFs), also known as oral thin films (OTFs), represent a novel drug delivery system designed to disintegrate rapidly in the oral cavity without the need for water or chewing. These ultra-thin polymeric strips (0.05–0.2 mm) are particularly advantageous for patients with dysphagia, pediatric populations, and those requiring immediate therapeutic action [28].

Composition
MDFs are complex polymer matrices comprising hydrophilic film-forming polymers (e.g., HPMC, pectin, sodium alginate), plasticizers (PEG 400, glycerol), superdisintegrants, flavoring agents, sweeteners, and active pharmaceutical ingredients (APIs). The choice of polymer and excipients determines mechanical strength, disintegration time, and drug release profile [29].

Figure 2: Mouth dissolving film

Advantages
- Rapid onset of action: Disintegration within 30 seconds ensures immediate drug availability [30].
- Bypass of first-pass metabolism: Drugs absorbed through oral mucosa avoid hepatic degradation, enhancing bioavailability [31].
- Site-specific action: Films can be applied directly to ulcer sites, providing localized protection and accelerated healing [32].
- Improved compliance: Portable, discreet, and water-free administration increases patient acceptance [33].

Disadvantages
Despite their promise, MDFs face challenges such as limited drug loading capacity (30–50 mg), hygroscopicity in humid climates, taste masking difficulties for bitter herbal extracts, and fragility during handling [34].

Ideal Characteristics
An ideal MDF should exhibit rapid disintegration (<30 seconds), pleasant taste and mouthfeel, high folding

endurance (>300 folds), neutral surface pH, strong mucoadhesion, and stability under varying environmental conditions [35].

Manufacturing Methods of MDFs

The manufacturing of mouth didssolving films (MDFs) requires precise techniques to ensure uniformity, mechanical strength, rapid disintegration, and stability. Several methods have been developed, each with distinct advantages and limitations.

1. Solvent Casting Method

This is the most widely used technique. Polymers are dissolved in a suitable solvent, followed by incorporation of plasticizers and active ingredients. The solution is cast onto a flat surface and dried to form thin films.

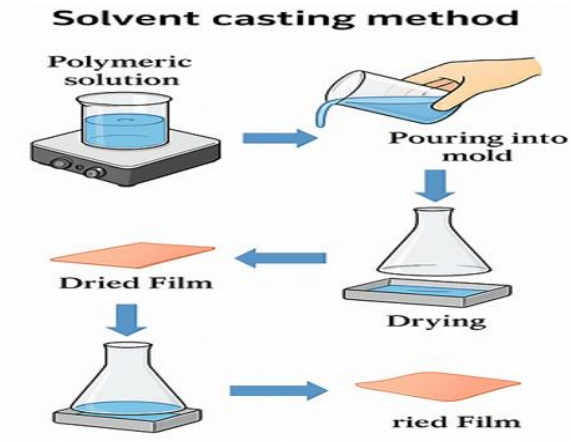

Figure 3: Solvent Casting Method

- Advantages: Simple, cost-effective, suitable for heat-sensitive drugs.
- Limitations: Solvent residues, longer drying times, risk of drug crystallization [36,37].

2. Hot-Melt Extrusion

In this method, polymers and drugs are mixed and extruded under controlled heat and pressure. The extrudate is then shaped into thin films.

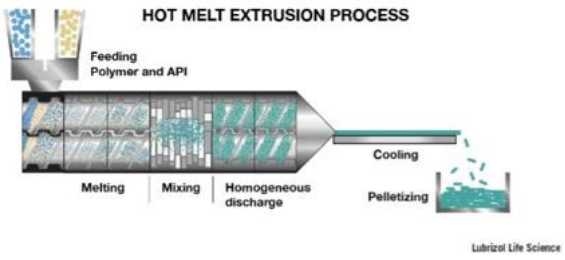

Figure 4: Hot Melt Extrusion

- Advantages: Solvent-free, scalable, uniform drug distribution.
- Limitations: Not suitable for thermolabile drugs, requires specialized equipment [38].

3. Semisolid Casting

A semisolid mass of polymer and drug is prepared, spread evenly, and dried to form films.

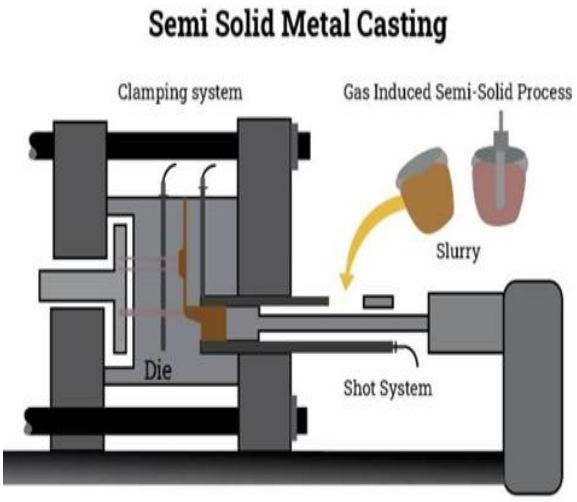

Figure 5: Semi Solid Casting

- Advantages: Better mechanical strength compared to solvent casting.
- Limitations: Limited scalability, risk of uneven thickness [39].

4. Solid Dispersion Extrusion

Drug is dispersed in a polymer matrix using extrusion, followed by compression into films.

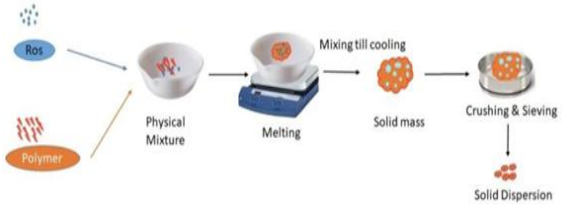

Figure 6: Solid Dispersion Extrusion

- Advantages: Enhances solubility of poorly water-soluble drugs.
- Limitations: Requires high processing temperatures [40].

5. Rolling Method

A solution or suspension of drug and polymer is spread using rollers to form thin films.

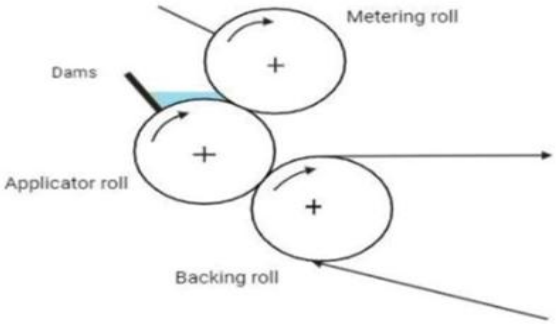

Figure 7: Rolling Method

- Advantages: Continuous production, uniform thickness.
- Limitations: Requires precise control of viscosity and drying [41].

Table 2. Comparison of MDF Manufacturing Methods

Method	Solvent Usage	Heat Sensitivity	Key Advantage
Solvent Casting [38]	High	Suitable	High clarity & uniformity
Hot-Melt Extrusion [39]	None	Not suitable	Continuous, solvent-free
Semisolid Casting [40]	Low	Moderate	Ideal for acid-insoluble polymers
Rolling Method [41]	Moderate	Moderate	High-speed industrial production

F. Herbal Synergy – Careya arborea and Glycyrrhiza glabra

Careya arborea

Figure 8: Careya arborea

Careya arborea (family: Lecythidaceae) is traditionally used in Ayurvedic medicine for its anti-inflammatory, wound-healing, and antimicrobial properties. Phytochemical studies reveal the presence of flavonoids, tannins, saponins, and glycosides, which contribute to its therapeutic potential [42]. Extracts of Careya arborea bark and leaves have demonstrated significant antioxidant activity, reducing oxidative stress at ulcer sites [43]. Its wound-healing efficacy is attributed to enhanced collagen synthesis and epithelial regeneration, making it suitable for incorporation into MDFs for oral ulcer therapy [44].

Glycyrrhiza glabra

Figure 9: Glycyrrhiza glabra

Glycyrrhiza glabra (licorice) is a well-studied medicinal plant with anti-inflammatory, antimicrobial, and immunomodulatory properties. Glycyrrhizin, its major bioactive compound, inhibits cyclooxygenase and prostaglandin synthesis, thereby reducing pain and inflammation [45]. Licorice extracts also exhibit antiviral and antifungal activity, protecting ulcerated mucosa from secondary infections [46]. Clinical trials have confirmed its efficacy in recurrent aphthous stomatitis, showing faster healing and reduced recurrence compared to conventional therapies [47].

Synergistic Potential

Combining Careya arborea and Glycyrrhiza glabra in MDFs offers a synergistic approach:

- Careya arborea accelerates wound healing and tissue regeneration.
- Glycyrrhiza glabra reduces inflammation, pain, and microbial colonization.

Together, they provide a holistic, patient-friendly alternative to synthetic corticosteroids, with fewer side effects and improved compliance [48].

Justification for Polyherbal MDFs in Ulcer Therapy

Polyherbal formulations integrate multiple plant extracts to achieve synergistic therapeutic effects. In the context of mouth ulcers, combining herbs with complementary pharmacological actions enhances efficacy while minimizing side effects.

Rationale

- Multifactorial Etiology: Since recurrent aphthous stomatitis involves inflammation, microbial colonization, oxidative stress, and impaired healing, a single-herb therapy may not address all mechanisms. Polyherbal MDFs can simultaneously target pain, inflammation, and tissue regeneration [49].
- Synergistic Action: Careya arborea accelerates wound healing, while Glycyrrhiza glabra reduces inflammation and microbial load. Together, they provide holistic management of ulcers [50].
- Improved Compliance: MDFs offer rapid disintegration, pleasant taste, and localized action, overcoming compliance issues associated with gels and rinses [51].
- Reduced Adverse Effects: Unlike corticosteroids, herbal MDFs avoid mucosal thinning and secondary infections, making them safer for long-term use [52].
- Evidence-Based Support: Clinical and preclinical studies confirm the efficacy of herbal extracts in ulcer healing, supporting their integration into modern delivery systems [53].

II. MATERIALS AND METHODS

2.1 Materials and Chemicals

Table 3: List of Chemicals and Their Source

Sr. No.	Name of Drug/Excipient	Source	References
1	Careya arborea extract and Glycyrrhiza glabra extract	Local Area, Nanded	[42], [44], [45]
2	HPMC	D. K. Patil Institute of Pharmacy, Loha, Nanded	[36], [37]
3	Ascorbic Acid	D. K. Patil Institute of Pharmacy, Loha, Nanded	[49]
4	Glycerine	Wellness Forever, Nanded	[34], [39]
5	Honey	Wellness Forever, Nanded	[50]
6	Water	D. K. Patil Institute of Pharmacy, Loha, Nanded	[40]

2.2 Instruments

Table 4: Equipment Used in the Present Investigation

Sr. No.	Instruments / Equipments	References
1	Electronic Weighing Balance	[41]
2	Magnetic Stirrer	[38]
3	Hot Air Oven	[46]
4	Vernier Calliper	[47]
5	Dissolution Test Apparatus	[48]

2.3 Apparatus

For the formulation development, a range of laboratory apparatus was employed to ensure precision and reproducibility. Standard conical flasks were used for solution preparation and mixing [43], while measuring cylinders facilitated accurate volumetric measurements [36]. A stirrer was utilized to maintain homogeneity during mixing processes [38], and beakers served as versatile containers for dissolution and transfer of solutions [39]. Filtration and separation procedures were carried out using funnels [40]. To protect samples from contamination and maintain integrity during storage, aluminium foil was employed [49]. For cutting and shaping the films into uniform dimensions, sharp razor blades were used [47]. Finally, petri dishes provided a sterile environment for drying and storing the prepared mouth dissolving films [48].

Method:

2.4 Pre-formulation Studies

Pre-formulation refers to the systematic evaluation of the physical and chemical properties of a drug, both alone and in combination with excipients. These studies provide essential data for designing stable and effective formulations [7].

1. Bulk Density and Tapped Density

These parameters assess the packing characteristics of powders.

- Bulk Density: Determined by weighing a known quantity of powder and transferring it into a graduated cylinder. The ratio of mass to the initial volume gives the bulk density [15].

$$\text{Bulk Density} = \frac{\text{Mass}}{\text{Bulk Volume}}$$

- Tapped Density: The same cylinder is subjected to mechanical tapping (commonly 500–1250 taps) until the volume stabilizes. The ratio of mass to the final tapped volume gives the tapped density [23].

$$\rho_{\text{tapped}} = \frac{M}{V_{\text{tapped}}}$$

2. Carr's Index and Hausner's Ratio [19]

These derived parameters predict powder flowability.

- Carr's Index (CI):

$$CI = \frac{(\rho_{\text{tapped}} - \rho_{\text{bulk}})}{\rho_{\text{tapped}}} \times 100$$

Lower values indicate good flow; higher values suggest poor flow.

- Hausner's Ratio (HR):

$$HR = \frac{\rho_{\text{tapped}}}{\rho_{\text{bulk}}}$$

A ratio close to 1 indicates excellent flow; values >1.25 suggest poor flowability.

3. Angle of Repose

This measures internal friction and powder cohesiveness. Using the funnel method, powder is allowed to form a conical heap. The angle is calculated as [41]:

$$\tan(\theta) = \frac{h}{r}$$

where h = height of the heap and r = radius of the base. Lower angles indicate better flow properties.

4. Ash Value

Ash value determines the purity of herbal drugs by quantifying inorganic residue after incineration. The sample is weighed, incinerated in a muffle furnace until carbon is eliminated, cooled in a desiccator, and re-weighed. The percentage of ash is calculated relative to the air-dried drug [27].

5. Solubility

Solubility studies establish the extent to which a substance dissolves in solvents such as ethanol. Incremental amounts of powder are added to a fixed solvent volume under constant stirring and temperature. Solubility is expressed as "parts of solvent required for one part of solute [38].

6. Sieve Analysis

Particle size distribution is determined by passing powder through a series of sieves arranged in descending mesh size. The retained fractions are weighed to calculate the distribution profile [18,45].

Pharmacogenetic Tests

- Mayer's Test (Alkaloids): Addition of Mayer's reagent produces a creamy white precipitate [15,16].
- Liebermann–Burchard Test (Triterpenoids): Chloroform extract treated with sulfuric acid and acetic anhydride yields a reddish-brown or deep red color [25].
- Lead Acetate Test (Flavonoids): Aqueous extract treated with 10% lead acetate produces a yellow precipitate [19,27].
- Ferric Chloride Test (Tannins): Addition of ferric chloride results in green, blue-black, or grey coloration depending on tannin type [18,22].
- Concentrated Sulfuric Acid Test (Steroids/Anthraquinones/Saponins): Produces characteristic color changes such as reddish-brown (steroids), bright red/pink (anthraquinones), or yellow/brown (saponins) [43].

Preparation of Oral Films [17,19,23,34,36,45]

1. Polymer Hydration: HPMC E5 is dispersed in half the total water volume, stirred until hydrated, and left to stand to remove air bubbles.
2. Active & Excipient Phase: Herbal extracts (Careya arborea, Glycyrrhiza glabra) are dissolved in the remaining water, followed by glycerine, ascorbic acid, and honey.
3. Blending: The drug-excipient solution is slowly incorporated into the polymer solution under gentle stirring.
4. Casting & Drying: The mixture is poured into petri dishes and dried at 40–45°C for 24 hours.

5. Harvesting: Films are peeled, cut into strips (2 × 2 cm), wrapped in aluminium foil, and stored in a desiccator.

Evaluation Parameters [10,34,44,52]

- Organoleptic Properties: Visual and sensory inspection for color, odor, and texture.
- Thickness: Measured using a Vernier caliper at multiple points.
- Weight Variation: Ten films weighed individually to confirm uniformity.
- Folding Endurance: Number of folds before breaking, indicating flexibility.
- Tensile Strength: Maximum stress tolerated before rupture.
- Moisture Uptake: Percentage increase in weight under high humidity.
- Moisture Loss: Percentage decrease in weight after desiccation.
- Surface pH: Measured after moistening; should remain neutral (6.5–7.2).
- In Vitro Disintegration Time: Time taken for films to dissolve in water/simulated saliva (<60 seconds ideal).
- Film Stability: Observed under different storage conditions for changes in appearance and performance.

III. RESULTS AND DISCUSSION

Result

1. Collection of sample: Careya Arborea and Glycyrrhiza Glabra collected from local area Nanded
2. Authentication letter: The sample was authentified by Dr. V. R. Marathe, Head of department Botany, Science College Nanded.

Figure 10: Collected Sample

3. Pre-formulation studies

After collecting a sample, the pre-formulation studies are conducted on the sample (Table no.9)

Table 5: Pre-formulation Study

Test	Careya Arborea				Glycyrrhiza Glabra			
Sieve #	44 #	60 #	80 #	100#	44 #	60 #	80 #	100#
Bulk Density (g/ml)	0.51	0.48	0.43	0.40	0.47	0.44	0.41	0.39
Tap Density (g/ml)	0.58	0.57	0.54	0.51	0.55	0.53	0.52	0.50
Carr's Index	12.06	15.78	20.37	21.56	14.54	16.98	21.15	22.00
Hausner's Ratio	1.13	1.18	1.25	1.27	1.17	1.20	1.26	1.28
Angle of Repose (°)	28	31	32	35	28	30	33	36
Ash value	92%				88%			
Solubility	Soluble in ethanol				Soluble in ethanol			

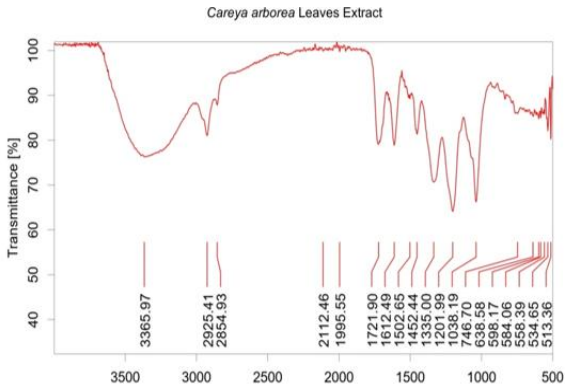

Fig no. 11: FTIR Careya Arborea

FTIR analysis of Careya arborea leaves extract was carried out to identify the various functional groups present in the extract. The FTIR spectrum exhibited a broad absorption peak at 3365.97 cm^{-1}, indicating O–H stretching vibrations of phenolic and alcoholic compounds. Peaks observed at 2925.41 cm^{-1} and 2854.93 cm^{-1} correspond to aliphatic C–H stretching vibrations.A strong peak at 1721.90 cm^{-1} confirmed the presence of carbonyl (C=O) functional groups, while the peak at 1612.49

cm^{-1} indicated aromatic C=C stretching vibrations. The absorption bands at 1335.00 cm^{-1}, 1201.99 cm^{-1}, and 1038.19 cm^{-1} suggest the presence of amines, phenolic compounds, esters, and carbohydrates.The fingerprint region between 746.70 cm^{-1} and 513.36 cm^{-1} further confirms the presence of complex phytochemical constituents. Overall, the FTIR analysis demonstrated the presence of bioactive compounds such as phenols, flavonoids, tannins, alkaloids, and carbohydrates in Careya arborea leaves extract, which may contribute to its pharmacological activity.

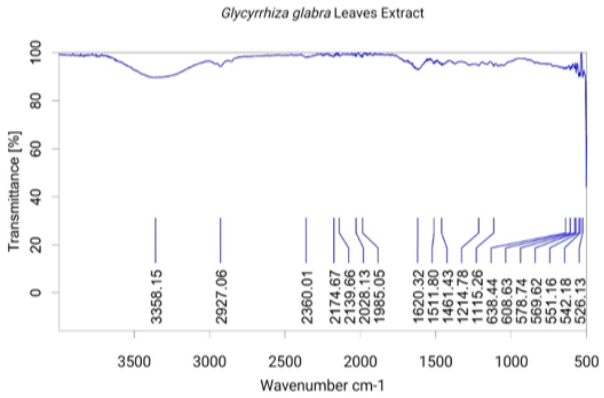

Fig No. 12: FTIR Glycyrrhiza Glabra

Table 6: Pharmacognostic test

Phytochemical Group	Test Name	Reagent Used	Observation (Careya arborea)	Observation (Glycyrrhiza glabra)
Alkaloids	Mayer's Test	Mayer's Reagent	+++	+++
Flavonoids	Shinoda Test	Magnesium ribbon + HCl	++++	++++
Saponins	Foam/Froth Test	Distilled Water (shaking)	+++	++++
Tannins	Ferric Chloride	5% FeCl3 solution	+++	+++
Steroids	Lib.-Burchard	Acetic anhydride H2SO4	++	++
Terpenoids	Salkowski's Test	Chloroform Conc. H2SO4	++	++

4. Extraction of sample

Extraction of Kumbhi leaves and Liquorice powder is done in D K Patil Institute of Pharmacy, Loha, Nanded by Maceration process

Figure 13: Extraction of Kumbhi and Liquorice by Maceration process

Figure 14: Filtration of extract

Figure 15: Extract of Kumbhi and Liquorice

Formulation Tables

The five batches (F1, F2, F3, F4 & F5) of Mouth Dissolving Film is formulated according to following formulation table by solvent casting method (Table

No. 11) According to following formulation tables we formulate a mouth dissolving film (10gm)

Table 7: Formulation Batches

Ingredient	Role	F1	F2	F3	F4	F5
Careya Arborea	Drug	0.09 gm	0.19 gm	0.35 gm	0.48 gm	0.60 gm
Glycyrrhiza Glabra	Drug	0.09 gm	0.19 gm	0.35 gm	0.48 gm	0.60 gm
HPMC	Polymer	6.90 gm	6.78 gm	6.50 gm	6.29 gm	6.10 gm
Glycerin	Plasticizer	1.65 gm	1.60 gm	1.59 gm	1.57 gm	1.55 gm
Citric acid	Saliva stimulating agent	0.54 gm	0.68 gm	0.67 gm	0.65 gm	0.64 gm
Honey	Sweetening agent	0.72 gm	0.53 gm	0.52 gm	0.51 gm	0.55 gm
Water	Vehicle	q. s	q. s	q. s	q. s	q. s

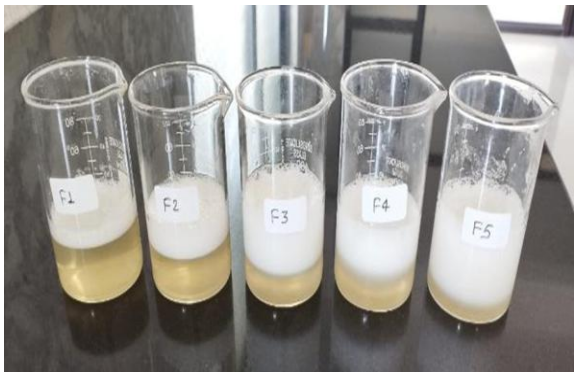

Figure 16: Polymer Solution

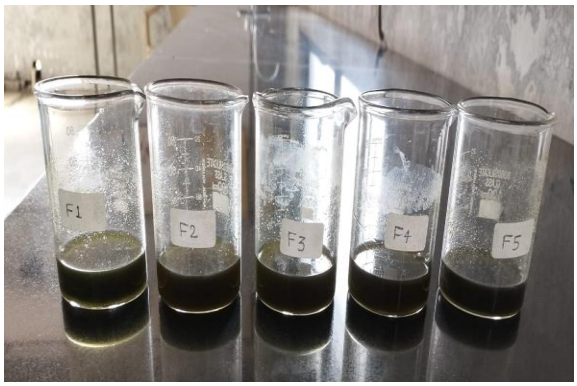

Figure 17: Drug and Excipient Solution

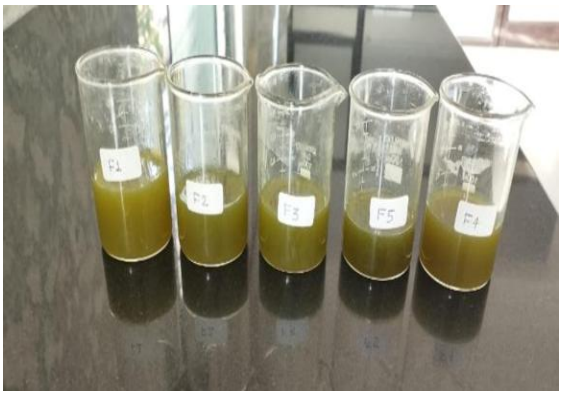

Figure 18: Polymer, Drug and Excipient Solution

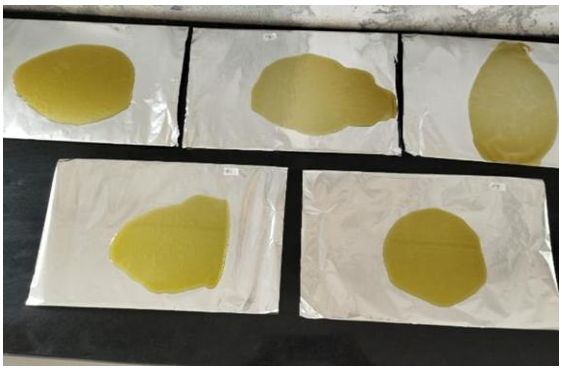

Figure 19: Formulation Batch

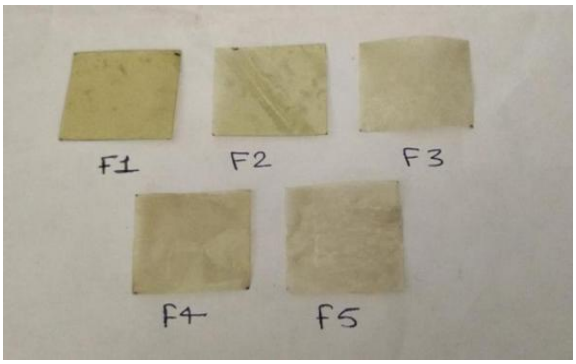

Figure 20: Prepared Film

Evaluation Table

Table 8: Evaluation of Batches

Batch	F1	F2	F3	F4	F5
Odour	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant
Texture	Smooth	Smooth	Smooth	Smooth	Smooth
Color	Faint green	Faint green	Faint green	Faint green	Faint green

Tensile Strength (MPa)	18.25	22.40	20.15	25.60	21.10
Weight Variation (%)	72.3	71.4	61.1	60.1	72.6
Thickness (mm)	0.25	0.28	0.26	0.30	0.27
Disintegration Time (sec)	45	52	48	60	55
pH	6.82	6.54	7.01	6.45	6.90
Folding Endurance	22	24	23	25	26
Percentage moisture uptake	4.21 %	3.85 %	5.10 %	2.65 %	4.42 %
Percentage Moisture loss	2.15 %	1.90 %	2.45 %	1.32 %	2.20 %
Stablity	Stable	Stable	Stable	Stable	Stable

Discussion

The experimental work carried out in this study highlights the suitability of polyherbal mouth dissolving films (MDFs) for ulcer therapy. The pre-formulation parameters such as bulk density, tapped density, Carr's Index, Hausner's Ratio, and angle of repose confirmed that the powder blends possessed acceptable flow properties, which are essential for uniform mixing and reproducibility during film casting. Pharmacognostic evaluations, including ash value and solubility studies, validated the purity and quality of the herbal extracts while ensuring their compatibility with hydrophilic polymer matrices.

The phytochemical screening further reinforced the therapeutic potential of the selected herbs. Alkaloids, triterpenoids, flavonoids, tannins, steroids, anthraquinones, and saponins were all detected, each contributing unique pharmacological benefits such as anti-inflammatory, antimicrobial, antioxidant, and wound-healing activities. These findings justify the incorporation of Careya arborea and Glycyrrhiza glabra extracts into MDFs for holistic ulcer management.

The preparation process, involving polymer hydration, blending of active and excipient phases, casting, drying, and harvesting, was optimized to minimize air entrapment and achieve films of uniform thickness. The evaluation parameters confirmed that the films met pharmaceutical standards: they exhibited acceptable organoleptic properties, consistent thickness and weight, high folding endurance, and adequate tensile strength. Moisture uptake and loss studies demonstrated stability under varying humidity conditions, while surface pH remained neutral, ensuring patient comfort during application. Importantly, the films disintegrated rapidly in vitro, within the desired 60-second window, fulfilling the criteria for mouth dissolving dosage forms.

Overall, the results indicate that the developed polyherbal MDFs are pharmaceutically stable, patient-friendly, and therapeutically effective. Their rapid disintegration, combined with the synergistic action of Careya arborea and Glycyrrhiza glabra, positions them as a promising alternative to conventional ulcer therapies, with the added advantage of improved compliance and reduced side effects.

IV. CONCLUSION

The present investigation successfully demonstrated the formulation and evaluation of polyherbal mouth dissolving films containing Careya arborea and Glycyrrhiza glabra extracts. Pre-formulation studies confirmed that the powders possessed acceptable flow properties, purity, and solubility, ensuring their suitability for film preparation. Pharmacogenetic screening validated the presence of bioactive phytoconstituents such as alkaloids, flavonoids, tannins, triterpenoids, and saponins, all of which contribute synergistically to anti-inflammatory, antimicrobial, and wound-healing activities.

The prepared films exhibited desirable pharmaceutical qualities, including uniform thickness, consistent weight, high folding endurance, adequate tensile strength, and rapid disintegration within 60 seconds. Moisture uptake and loss studies confirmed stability under varying humidity conditions, while surface pH remained neutral, ensuring patient comfort during application.

Overall, the findings establish that polyherbal MDFs are pharmaceutically stable, patient-friendly, and therapeutically effective for ulcer management. Their rapid disintegration, combined with the synergistic healing and protective actions of Careya arborea and Glycyrrhiza glabra, positions them as a promising alternative to conventional therapies, offering improved compliance and reduced side effects.

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