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Formulation and Evaluation of Costus Ignus-Loaded Buccal Films for Enhanced Drug Delivery

Avishkar Khedkar[1], Siddesh Shelake[2], Anudip Dhavale[3], Rutuja Chavan[4]
Department of Pharmacognasy[1-4]
Samarth Institute of Pharmacy, Belhe, Junnar
avikhedkar098@gmail.com

Abstract: *This study is about making and testing buccal films (thin strips placed inside the cheek) that contain an extract from the Costus igneus plant, also known as the "Insulin Plant." This plant is known for helping manage diabetes and has other health benefits too. Using the buccal route for drug delivery is better than swallowing pills because it avoids the liver's first-pass metabolism and allows the medicine to work faster.In this project, the films were made with the right mix of natural ingredients, including safe polymers and plasticizers, to hold the plant extract properly. These films were then tested for things like appearance, flexibility, strength, pH level, how quickly they break down, and how steadily the extract is released. The best version of the film showed good strength, proper drug release, and was easy to use in the mouth. This method offers a gentle, non-invasive way to deliver herbal medicine and may be a better option for long-term treatment of conditions like diabetes.*

Keywords: Costus igneus, Insulin plant, Buccal drug delivery, Mucoadhesive films

I. INTRODUCTION

In an age when consumers are increasingly health-focused and seek effective, safer, natural alternatives for controlling chronic health issues, such as diabetes, These contemporary medicines are highly efficacious, their use involves adverse effects, particularly with long-term use. Many researchers UK are investigating herbal medicines, which are more natural, less toxic and frequently more easily tolerated by the patients.

One of these mighty medicinal plants that make this list is Costus igneus otherwise known as the "Insulin Plant". More recently, it has become popularized for its potential to assist with lowering blood sugar and improving overall symptoms among those with diabetes. It is packed with powerful flavonoids, alkaloid and glycoside compounds that all combine together to heal the body by restoring its natural function. Historically, humans have eaten the leaves of this plant or included its extract in traditional medicines. The route of administration certainly has a huge impact on efficacy and with herbal medicines, how we take them is even more critical.

When we consume herbal medicines orally, such as in powdered, syrup, or capsule forms, the body has to rely on the digestive system, which can destroy much of the active ingredients and their potencies before they're absorbed into the bloodstream. This process, referred to as first-pass metabolism, occurs largely in the liver and can significantly decrease the drug's potential therapeutic effect. That's why it is crucial to develop more effective forms of administering the drug directly into the bloodstream.

One such solution that's looking very promising are buccal films. These are little, thin strips that dissolve when you place them between your gum and cheek. The herbal medicine featured in the film is most effectively absorbed directly into the blood through the tissues in your mouth, avoiding the digestive tract and liver. This is a neat justice win Teagle's approach is faster, according to researchers, and keeps more of the medicine active and effective. It's a much easier, pain-free route of administrating medicine which is a great alternative for patients that dislike pill swallowing or have issues with adherence to their medicine regimen.

In this investigation, we entirely targeted to formulate buccal films containing Costus igneus extract. We chose appropriate ingredients such as polymers and plasticizers to provide these films with flexibility, smoothness and stability. The films were rigorously characterized and tested to confirm that they had appropriate thickness, pH, drug

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loading and folding endurance. We further examined the rate of oral degradation as well as the rate of sustained release of the herbal extract over time.

Our overall objective was to produce an efficient, safe, non-toxic, convenient, and patient-friendly herbal sublingual film that could be utilized in diabetic glycemic control and likely other chronic diseases. By harnessing the natural healing power of Costus igneus with cutting-edge drug delivery technology, this research hopes to provide an alternative that is both scientifically rigorous and practical for daily use. This approach does more than maximize the impact of herbal medicine. It also makes it easier and more enjoyable for apatients to stay on track with their treatment.

In summary, Costus igneus-loaded buccal films of a properly optimized formulation might be a wise and optimistic approach to disseminating the benefits of herbal medicine to a wider populace, particularly to patients seeking safer and more natural therapeutic alternatives.

DRUG PROFILE

Parameter	INFORMATION
Plant Name	Costus igneus
Synonyms	Spiral Flag, Insulin Plant
Image	
Origin	Native to Southeast Asia; widely cultivated in India and tropical regions
Biological Source	Fresh or dried leaves of *Costus igneus*
Family	Costaceae
Chemical Constituents	Flavonoids, Saponins, Alkaloids, Tannins, Glycosides, Steroids
Uses	Antidiabetic, antioxidant, anti-inflammatory, antimicrobial, hepatoprotective
Kingdom	Plantae
Phylum	Angiosperms
Genus	Costus
Class	Monocotyledonae

MATERIAL AND METHODS

1. Materials

Costus igneus leaves were collected fresh and authenticated by a botanist. The plant material was shade-dried and powdered for extraction. The following excipients were used in the formulation of buccal films: Hydroxy Propyl Methyl Cellulose (HPMC), Sodium Carboxy Methyl Cellulose (SCMC), Polyvinyl Alcohol (PVA), Propylene Glycol (PG), Sorbitol, Menthol, and Chloroform—all procured from the institutional laboratory-grade stock. All chemicals and reagents used were of analytical grade.

2. Procedure-

1. Extraction of Plant Material

→ Maceration of Costus igneus leaves

→ Filtration to obtain extract

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2. Preparation of Backing Membrane
→ Dissolve PVA in water
→ Pour into petri dish
→ Dry in hot air oven at 40°C
→ Backing membrane ready

3. Preparation of Polymer Solutions:
Accurately weighed HPMC was dissolved in 10 mL of distilled water and stirred with a magnetic stirrer for 15 minutes. Separately, SCMC was dissolved in another 10 mL of water and stirred for 15 minutes.

4. Mixing of Polymer Solutions:
Both polymeric solutions were combined and mixed thoroughly at 60°C for 45 minutes using a magnetic stirrer to ensure uniform blending.

5. Incorporation of Extract and Excipients:
The Costus igneus extract (in place of Enalapril Maleate) equivalent to the desired concentration was added to the above polymer solution.
Propylene glycol (plasticizer), sorbitol (sweetening agent), and menthol (flavoring/cooling agent) were added and mixed thoroughly.

6. Casting of Films:
The final solution was poured onto a PVA backing membrane placed in a petri dish.

7. Drying:
The films were dried by exposing them to 40°C in a hot air oven for 24 hours.

8. Packaging and Storage:
The dried buccal films were carefully peeled off and packed in aluminum foil.

SR.NO	Ingredient	Batch 1	Batch 2	Batch 3	Batch 4	Batch 5
1	Drug (mg)	318	318	318	318	318
2	SCMC (mg)	1000	800	600	400	200
3	HPMC (mg)	0	200	400	600	800
4	Glycerine (ml)	0.238	0.238	0.238	0.238	0.238
5	Sodium saccharin (mg)	0.078	0.078	0.078	0.078	0.078
6	Menthol (ml)	0.11	0.11	0.11	0.11	0.11
7	Distilled water (ml)	30	30	30	30	30

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Evaluation :

Organoleptic Evaluation: The formulated mucoadhesive buccal films were evaluated for organoleptic characteristics like color, odor and shape. All the films were visually inspected for color and shape.

Taste – Bitterness

Odor – Herbal and unpleasent

Mouthfeel – Smoothness, Non- stickness

Physical Evaluation:

1.Appearance:

Colour - brown

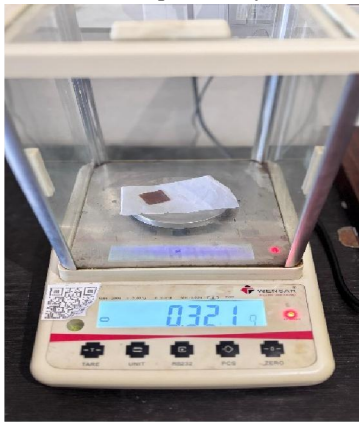
Shape – Square

Surface – Smooth and Uniform

2. Thickness:

Measured at multiple points with a screw gauge; average thickness and. Ten buccal film were randomly selected and their thickness was measured individually. Thickness of buccal film is 0.3mm

3. Weight of the film: To assess the consistency of the weight of individual buccal film within a batch. Uniformity in weight can indicate consistent ingredient distribution and potentially consistent dissolution time.



4. Surface pH study: The surface pH of the patch was determined in order to investigate the possible side effects of the drug. A combined glass electrode was used for this purpose. The patches were allowed to swell when kept in 1 ml of distilled water (pH 6.6±0.2) for 15 min at room temperature, and pH of the film is studied

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5. Content uniformity:

To ensure uniform distribution of Flavonoids in film, a content uniformity test was performed. The film was added to 100 ml of phosphate buffer pH 6.8 contained in a 250 ml beaker, which was placed on temperature controlled magnetic stirrer maintained at 37°C. The medium was stirred at 300 rpm with a Teflon coated magnetic bead for 3 hrs.Then, the solution was filtered through 0.45 µm membrane filter, the filtrate was examined for the drug content at 266 nm using UV-Spectrophotometer.

6. Percentage moisture absorption and loss:

Films kept in different humidity conditions (saturated salt & calcium chloride) and reweighed after 3 days. Percentage Moisture Absorption and Loss calculated.

Results:

Buccal films containing **Costus igneus** extract were successfully prepared using suitable film-forming agents and excipients. Batch BF5 was selected as the optimized formulation based on its satisfactory physical properties, drug content, and mucoadhesive behavior. The following parameters were evaluated:

Parameter	Result for BF5
Appearance	Transparent, smooth surface
Weight Uniformity	0.321g
Thickness	0.24
Folding Endurance	>300 times
Surface pH	6.5(close to salivary pH)
Drug Content Uniformity	98.4%
Disintegration Time	45 seconds
In vitro Drug Release (30 min)	96.2%
Mucoadhesive Strength	32 g
Swelling Index	142%

II. CONCLUSION

The present study successfully demonstrated the formulation and evaluation of herbal buccal film containing Costus igneous for the management of Diabetes. The selected herbs are well-known for their Anti- diabetic properties. The formulated buccal film showed satisfactory results in terms of physical parameters, taste, and release profile.This herbal buccal film formulation offers a promising, natural, and patient-friendly alternative to conventional for anti-diabetic medications. Further in-vivo studies or clinical evaluations are recommended to establish efficacy and safety in larger populations.

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