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Formulation and Evaluation of Antibacterial Mucoadhesive Buccal Patches Containing Ocimum Sanctum and Glycyrrhiza Glabra Extracts for Halitosis Management

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Abstract: ***This study focuses on developing an antibacterial fragrant buccal patch to help manage halitosis, a common oral problem mainly caused by microbial activity in the mouth. The patch is designed to provide long-lasting antibacterial action along with the study concluded that for improved breath freshness. Herbal extracts of*** **Ocimum sanctum** ***and*** **Glycyrrhiza glabra** ***were selected for their well-known antibacterial, anti-inflammatory, deodorizing, and soothing properties.*** **Ocimum sanctum** ***helps control odor-causing microorganisms, while*** **Glycyrrhiza glabra** ***supports oral comfort and reduces irritation. Together, these herbal ingredients offer sustained antimicrobial activity and effective control of halitosis. The buccal patch allows localized delivery, prolonged retention in the oral cavity, and better patient compliance, without the use of synthetic flavors or harsh chemicals. Overall, the developed herbal buccal patch presents a safe and effective approach for maintaining oral freshness and managing halitosis.***

Keywords: Herbal buccal patch, Ocimum sanctum (Tulsi), Glycyrrhiza glabra (Liquorice), Natural antimicrobial agents

1. Introduction

A buccal patch is a drug delivery formulation made of one or more polymer layers that contain the drug and other excipients. It usually has a mucoadhesive polymer layer that helps the patch attach to the oral mucosa, gums, or teeth. This attachment allows the drug to be released slowly and in a controlled manner. The patch should not interfere with normal activities such as talking or drinking. It should remain attached to the application site for a few hours to ensure proper drug delivery. The formulation must be comfortable to use and should not cause irritation at the site of application. The drug release should mainly occur toward the mucosal surface. In some cases, the drug may also be released into the oral cavity. Therefore, buccal patches can provide unidirectional drug release toward the mucosa or oral cavity, or bidirectional release toward both. (1)

2. Materials and Methods

1) TULASI

Family: Labiatae

Tulasi is an annual herb (30–75 cm tall) with purplish hairy stems, containing compounds like eugenol, β-caryophyllene, and ursolic acid, and it is widely used for its aromatic, medicinal, and therapeutic properties in treating cough, cold, fever, gastric disorders, and other ailments.(2)

2) Liquorice

Family: Fabaceae

Liquorice consists of peeled and unpeeled stolons, roots, and subterranean stems of *Glycyrrhiza glabra* Linn.[30] It is brown to dark brown externally and yellowish internally, with a faint odour and sweet taste. It contains 10–15% glycyrrhizin along with glycyramarin, resins, carbenoxolone, and liquiritin. Liquorice is used as a sweetening agent, expectorant, antibacterial, antistress, and antipyretic, and in the treatment of chronic inflammation and skin disorders.(3)

3) Hydroxypropyl Methyl Cellulose (HPMC)

Hydroxypropyl methylcellulose (HPMC) is a non-toxic polymer widely used in pharmaceutical formulations. It is an odorless, tasteless, white to slightly off-white powder used for emulsification, thickening, suspension, adhesion, film formation, and gelation. HPMC acts as a binder, disintegrant, coating polymer, and release-controlling excipient, helping improve drug solubility, bioavailability, and controlled drug release.

4) Polyethylene Glycol (PEG)

Polyethylene glycol (PEG) is a hydrophilic, synthetic, non-toxic, and biocompatible polyether that is soluble in water and many organic solvents. It is used as a plasticizer, solubility enhancer, and as a key component in mucoadhesive drug delivery systems.

5) Polyvinylpyrrolidone (PVP)

Polyvinylpyrrolidone (PVP) is a polymer made from N-vinylpyrrolidone monomer. It is water-soluble, inert, non-toxic, pH-stable, and biocompatible. It is used as a film former, binder in buccal mucoadhesive formulations, and also acts as a thickening agent and stabilizer.

6) Propylene Glycol

It is a colorless, odorless, slightly viscous and hygroscopic liquid that is soluble in water and many organic solvents. It is considered low-toxic and safe for use in cosmetics, pharmaceuticals, and the food industry. It is used as a solvent, vehicle, humectant, and stabilizer in various formulations.

7) Ethanol
It is a colorless, volatile, and highly flammable liquid with a pleasant odor, miscible with water and many organic solvents. It is used as an intoxicating ingredient, fuel, preservative, medicine, and in the preparation of organic compounds.

8) Peppermint Oil
It is a clear to pale yellowish liquid with a strong menthol odor and cooling sensation, obtained from *Mentha piperita* by steam distillation. It is used as a flavoring agent, fragrance agent, and masking agent in various products.

9) Triethanolamine
Triethanolamine is a clear, colorless to pale viscous liquid widely used in cosmetics and pharmaceutical products. It acts as a pH adjuster, emulsifier, thickener, solvent, and skin-conditioning agent.

10) Vanillin
Vanillin is a slightly yellowish crystalline powder with a strong vanilla aroma, soluble in hot water, ethanol, ether, and chloroform, with a melting point of 81–83 °C. It is used as a flavoring agent in food and pharmaceuticals, as a fragrance in soaps and candles, and also acts as a mild antibacterial agent.

3. Methodology

- Take 10g of herbal powder in a beaker.
- Add 100ml of distilled water.
- Heat it at 60-70℃ for 30-45minutes.
- Cool this mixture at room temperature and filter through trained sensory panel.
- Evaporate the filtrate on a Whatman filter paper [4]

S. No.	INGREDIENTS	F1	F2	F3
1	TULASI EXTRACT	2mg	2mg	2mg
2	LIQUORICE EXTRACT	2mg	2mg	2mg
3	HPMC	0.48g	0.21g	0.48g
4	PVP K30	0.34g	0.23g	0.34g
5	PEG 6000	0.27g	0.18g	0.34g
6	PROPYLENE GLYCOL	1ml	0.5ml	1ml
7	VANILLIN	2mg	2mg	2mg
8	PEPPERMINT OIL	0.5ml	0.5ml	0.5ml
9	TRIETHANOLAMINE	qs	qs	qs
10	ETHANOL	12.5ml	8.5ml	12.5ml
11	WATER	12.5ml	8.5ml	12.5ml

4. Evaluation

1) Organoleptic Evaluation
The prepared formulation was evaluated for their organoleptic properties such as colour, odour, texture and hardness. The colour & texture was evaluated by vision and touch and the odour was evaluated by forming a group of odour sensitive people and sampling was performed.[5]

2) Thickness
The thickness is another parameter to be taken into consideration. The formulation should have a uniform thickness all over the area. The thickness was determined by using a screw gauge.[6]

3) Weight
The weight of the patch was determined by using a weighing balance.

4) pH
Determining the pH is a crucial parameter. As the pH of the formulation may affect the mucous membrane, thus variations in pH may cause harmful effects. So, it is important to formulate the patches in the appropriate pH to that of the mucous membrane.[7]

5) Folding Endurance
Folding endurance is determined to evaluate the mechanical strength, flexibility, and resistance to breakage of the prepared mucoadhesive buccal patches.[8]

6) Antimicrobial Study
Antimicrobial study test was conducted to determine the degree of efficacy of extracts used in buccal patch against bacterial species. Antimicrobial study for the buccal patch was performed by well diffusion method.[9]

5. Result and Discussion

S No	Organoleptic Evaluation Parameter	F1	F2	F3
1	Colour	Creamish White	Creamish White	Creamish White
2	Odour	Minty	Minty	Minty
3	Texture	Smooth	Smooth	Smooth

S. No	Evaluation Parameters	F1	F2	F3
1	Patch Weight	52mg	48mg	54mg
2	pH	6.20	6.70	6.44
3	Thickness	0.40mm	0.30mm	0.41mm
4	Folding Endurance	175	201	152

6. Discussion

The combination of herbal ingredients such as Ocimum sanctum and Glycyrrhiza glabra provides a range of potentially beneficial properties, including antimicrobial, antibacterial, antiinflammatory, soothing effects. The presence of these diverse phytochemicals in the extracts suggests the potential use of these ingredients in the herbal patch. The alkaloids, eugenol, flavonoids, phenolic, and terpenoids identified are known for their antibacterial, antioxidant, anti-inflammatory, and potentially other beneficial properties. These properties could contribute to the efficacy of the patch in addressing issues like halitosis, dental caries and Gingivitis. Upon evaluating the different parameters of evaluation that we had done with the all three formulations, optimum characteristics and stability were observed for F2 formulation than F1 and F3. The study was finalized that F2 h optimum weight, thickness, pH, folding endurance and antimicrobial property, which is usually needed for a better antibacterial.

7. Conclusion

Buccal patches are an effective and patient-friendly drug delivery system that provide prolonged drug action and easy

administration. In this study, an antibacterial fragrant buccal patch was formulated using herbal ingredients *Ocimum sanctum* (Tulsi) and *Glycyrrhiza glabra* (Liquorice), known for their antibacterial, anti-inflammatory, and healing properties. The herbal components also provided a natural minty aroma, improving patient acceptability. The formulated patch was evaluated for physicochemical properties and antibacterial activity, and the results showed satisfactory performance and stability. Thus, the herbal buccal patch can be considered a safe and promising alternative to conventional synthetic formulations for maintaining oral hygiene and controlling microbial infections.

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