

FORMULATION AND EVALUATION OF MUCOADHESIVE BUCCAL TABLETS: A REVIEW

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ABSTRACT

Mucoadhesive buccal tablets have emerged as a promising drug delivery system for improving bioavailability, reducing first-pass metabolism, and enhancing patient compliance. This review aims to provide a comprehensive overview of the formulation and evaluation strategies for mucoadhesive buccal tablets. Various mucoadhesive polymers, including natural and synthetic polymers, are discussed. The review also covers the factors influencing mucoadhesion, such as polymer concentration, molecular weight, and pH. Additionally, the evaluation parameters, including mucoadhesive strength, *ex vivo* residence time, and *in vitro* drug release, are discussed. The challenges and future directions in the development of mucoadhesive buccal tablets are also highlighted. This review provides a valuable resource for researchers and pharmaceutical scientists working on the development of mucoadhesive buccal tablets.

Key words: Mucoadhesion, buccal tablets, polymers, *in vitro* drug release, mucoadhesive strength.

INTRODUCTION

The oral route of drug administration is the most common and preferred route for drug delivery, as it enables easy ingestion, self-medication, accurate dosage, flexible and controlled dosing schedule, and patient compliance with a low chance of administration difficulty. It shows the disadvantages of first-pass effect, gastrointestinal enzymatic degradation, and slow onset of action. To reduce these demerits, mucoadhesive drug delivery and sublingual drug delivery are suggested as best alternatives. Buccal drug delivery has several advantages over to conventional oral route, drug directly enter into systemic circulation via buccal mucosa, avoids first pass metabolism and rapid onset of action. Dosage forms can be easily applied and drug action can be terminated in emergency and unexpected side effects by removing the dosage form. There are different mucoadhesive dosage forms currently available in the

market for local or systemic drug delivery. Buccal tablets can be formulated to retain their shape, integrity, and position during application time.

Mucoadhesive dosage forms are mainly designed to adhere the surface of the mucus. And so intensifying retention of the drug at the site of application at the time of providing a controlled rate of drug release for better therapeutic response. Some of the mucoadhesive drug delivery systems are adhesive patches, adhesive gels, adhesive tablets, adhesive films and adhesive discs, etc. The routes of this systems are gastrointestinal (GI) tract, the urogenital tract, the ear, the nasal route, and the airways in the body are lined by the mucosal layer. These are either single-layered epithelium found in the GI tract, bronchi, and intestines or multilayered stratified epithelium found in the esophagus, vagina, and cornea are potential sites where mucoadhesive drug delivery systems can be useful.

Buccal delivery is used to overcome the deficiencies associated with the oral route of drug administration. Drug degradation in the GIT environment and first pass metabolism can be circumvented by administering the drug through buccal route. The drug can be applied locally in the oral cavity and may be removed easily at any time during the treatment period. For the development of mucoadhesive systems, mucoadhesion of the device is a key element. For proper mucoadhesion, mucoadhesive polymers are used. The addition of polymers to the drug delivery systems will increase the duration of attachment of dosage form to the mucous surface and also increases the efficacy.

Mucus: Mucoadhesive inner layers called mucosa inner epithelial cell lining is covered with viscoelastic fluid.

- * Composed of water and mucin.
- * Thickness varies from 40 μm to 300 μm .

General composition of mucus:

- * Water.....95%
- * Glycoproteins and lipids.....0.5-5%
- * Mineral salts.....1%
- * Free proteins.....0.5-1%

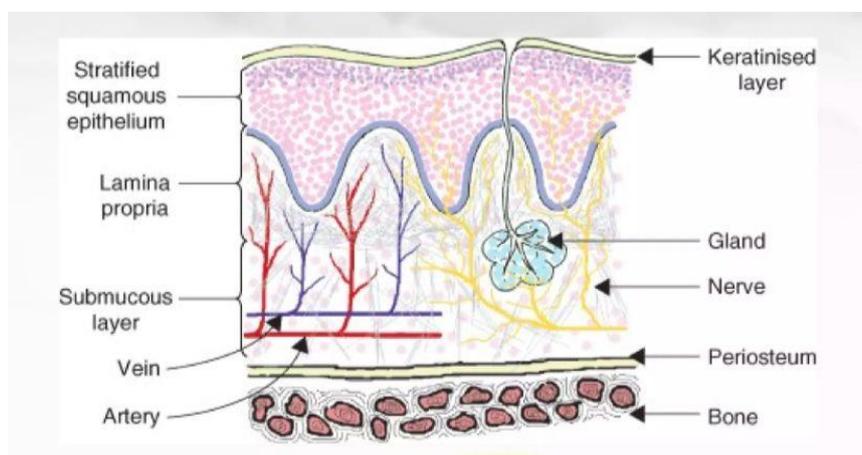


Fig.1. general structure of mucus layer

Mucoadhesion:

Mucoadhesion is used to define the attachment of macromolecules to the mucosal membrane. After application to the oral cavity, dosage forms may become dislodged and swallowed accidentally by the patients. This may cause interruptions or reduction in drug absorption during treatment. For this reason, it is important to provide sufficient mucoadhesion to retain the buccal tablet on the application site. Various natural, semi-synthetic, or synthetic polymers are used in buccal formulations to achieve mucoadhesion. These polymers hydrate and swell with contact to mucus layer in the epithelium. Mucin, a specific component of mucus, is a high-molecular-weight glycoprotein with negative charge on the surface. Mucoadhesion strength varies based on the physicochemical properties of the polymer, characteristics of the biological material, and contact time of the dosage form.

Mucoadhesive drug delivery system: Mucoadhesive delivery system is the part of controlled drug delivery system. Mucoadhesive drug delivery system interact with the mucus layer covering the mucosal epithelial surface and increase the residence time of the dosage form at the site of absorption. The ability to maintain a delivery system at a particular location for an extended period of time has great appeal for both local as well as systemic drug bioavailability. Mucoadhesive drug delivery systems facilitate the possibility of avoiding either destruction by gastrointestinal contents or hepatic first-pass inactivation of drug.

Mucoadhesion stages: For mucoadhesion, 3 stages are involved:

- i) An intimate contact in-between a mucoadhesive and a membrane either from a good wetting of the mucoadhesive and a membrane or from the swelling of mucoadhesive.
- ii) Penetration of the mucoadhesive into the tissue takes place.
- iii) Inter penetration of the chains of mucoadhesives with mucous takes place and then low chemical bonds can settle.

Mechanisms of mucoadhesion: It involves in 3 steps,

1. Wetting and swelling of polymer.
2. Interpenetration between the polymer chains and the mucosal membranes.
3. Formation of bonds between the entangled chains.

Step 1:

*Wetting and swelling step occurs when polymer spreads over the surface mucosal membrane to develop intimate contact.

* Swelling of the polymer occur because the components of the polymer ha affinity for water.

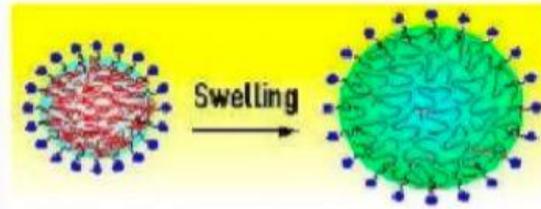
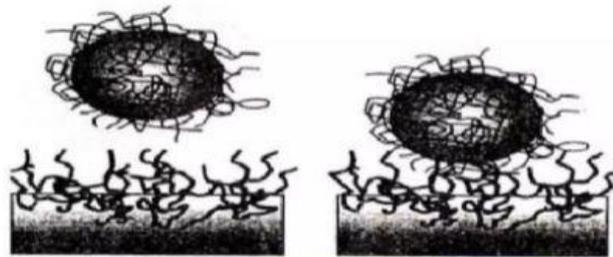


Fig.2. wetting and swelling of polymer

Step 2:

- * The surface of mucosal membranes are composed of glycoproteins
- * In this step the mucoadhesive polymer chain and the mucosal chains intermingles and entangles to form adhesive bonds.
- * Strength of the bond depends upon the degree of penetration of the two polymer groups.
- * In order to form strong adhesive bonds, one polymer group must be soluble in the other and the both the polymer must be of a similar chemical structure.



Interpenetration of mucoadhesive and mucous polymer chains

Fig.3. interpenetration

Step 3:

- * This step involves formation of weak chemical bonds between entagled chains.
- * This type of bonding formed between the chains include bonds such as hydrogen bonds.

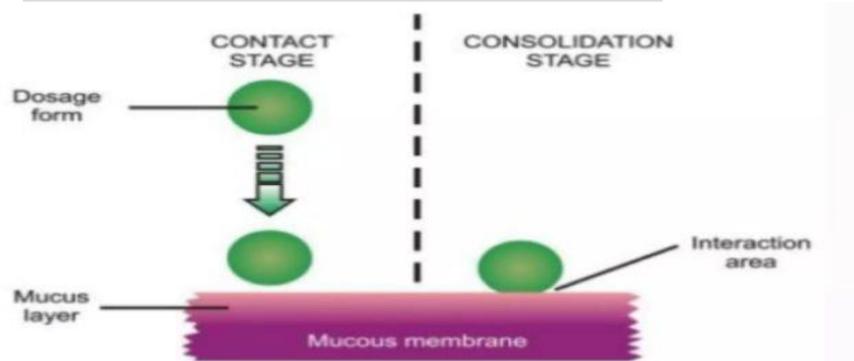


Fig.4. formation of bonds

Buccal mucoadhesive tablets:

- * The mucoadhesive tablets are most preferable mucoadhesive device in order to improve bioavailability.
- * Buccal tablets are small, flat, and oval shaped dosage form.
- * They are soften, adhere to the mucosa, and are retained in position until dissolution and or release is complete.
- * Tablets are placed in buccal pouch below the muscles of teeth.

* These tablets can be applied to different sites in the oral cavity, including the palate, the mucosa lining, the cheek, as well as the lip and the gum.

* Tablets that are placed directly onto the mucosal surface have been formulated.

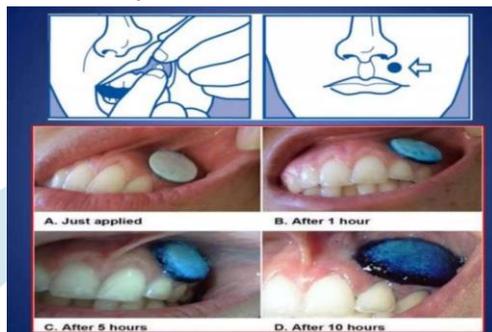


Fig.5. buccal Tablets

Applications of mucoadhesive buccal tablets:

Systemic drug delivery:

1. Pain management: Mucoadhesive buccal tablets can deliver opioids and other pain medications systemically, providing rapid relief from pain.
2. Cardiovascular diseases: These tablets can deliver medications for hypertension, angina, and other cardiovascular conditions.
3. Diabetes management: Mucoadhesive buccal tablets can deliver insulin and other antidiabetic medications systemically.

Localized drug delivery:

1. Oral ulcers: Mucoadhesive buccal tablets can deliver drugs directly to oral ulcers, promoting healing and reducing pain.
2. Gingivitis: These tablets can deliver antibacterial agents to the gums, reducing inflammation and preventing infection.
3. Mouth sores: Mucoadhesive buccal tablets can provide relief from mouth sores caused by chemotherapy, radiation, or other conditions.

Other applications:

1. Vaccination: These tablets can deliver vaccines orally, providing a non-invasive and pain-free alternative to injections.
2. Gene therapy: Mucoadhesive buccal tablets can deliver genetic material to specific sites in the body, enabling targeted gene therapy.

Advantages of mucoadhesive buccal tablets:

- * Ease of administration.
- * Termination of therapy is easy.
- * Permits localization of drug to the oral cavity for a prolonged period of time.

- * Can be administered to unconscious patients.
- * Offers an excellent route, for the systemic delivery of drugs with high first pass metabolism, thereby offering a greater bioavailability.
- * A significant reduction in dose can be achieved thereby reducing dose related side effects.

Disadvantages of mucoadhesive buccal tablets:

- * Drugs, which irritate the oral mucosa, have a bitter or unpleasant taste, odour; can not be administered by this route.
- * Drugs, which are unstable at buccal pH cannot be administered by this route.
- * Only drugs with small dose requirements can be administered.
- * Drugs may swallow with saliva and loses the advantages of buccal route.
- * Only those drugs, which are absorbed by passive diffusion can be administered by this route.
- * Eating and drinking may become restricted.

Reasons for review:

Growing interest in alternative drug delivery systems: Mucoadhesive buccal tablets offer a promising alternative to traditional oral and injectable routes of administration.

Limited understanding of mucoadhesion mechanisms: A comprehensive review can help clarify the complex mechanisms involved in mucoadhesion and how they impact drug delivery.

Need for optimized formulation and evaluation methods: A review can provide guidance on optimizing formulation and evaluation methods for mucoadhesive buccal tablets, ensuring consistent and reliable results.

Increasing demand for patient-centric drug delivery systems: Mucoadhesive buccal tablets offer a patient-friendly alternative to traditional drug delivery systems, and a review can help highlight their potential benefits.

CONCLUSION

It is here by concluded that, Mucoadhesive buccal tablets have emerged as a promising drug delivery system, offering improved bioavailability, prolonged release, and enhanced patient compliance. This review highlights the various formulation strategies, mucoadhesive polymers, and evaluation techniques employed to design and optimize mucoadhesive buccal tablets. However, further research is needed to overcome the challenges associated with mucoadhesive buccal tablets, such as limited mucosal surface area, variable mucosal pH, and potential irritation. Overall, mucoadhesive buccal tablets offer a promising platform for the delivery of therapeutic agents, and continued research and development are necessary to fully realize their potential.

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