IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

REVIEW ON MUCOADHESIVE DRUG DELIVERY SYSTEM

1Roshni Nikalje, 2Pritam Patil, 3Harshada Pardhi, 4Amruta suryawanshi, 5Godavari Bramha

1student, 2student, 3student, 4student, 5assistant professor

1dbatu university kbiper talegaon dabhade,

2dbatu university kbiper talegaon dabhade,

3dbatu university kbiper talegaon dabhade,

4dbatu university kbiper talegaon dabhade,

5Dbatu university kbiper talegaon dabhade

1 ABSTRACT:

administration, offering a solution to the challenges associated with conventional oral drug delivery methods. A drug compound administered orally or buccally exhibit The buccal region within the oral cavity has emerged as a promising site for drug a rapid onset of action, surpassing the efficiency of traditional oral routes. moreover this delivery method allows for the prompt removal of the dosage form when needed. Notably , buccal drug delivery is particularly advantageous for patients who are unconscious or have limited cooperation.

Mucoadhesive drug delivery systems interact with the mucus layer covering the mucosal epithelial surface, and mucin molecules and increase the residence time of the dosage form at the site of absorption. The drugs which have local action or those which have maximum absorption in gastrointestinal tract (GIT) require increased duration of stay in GIT.

2 KEYWORDS:

Mucoadhesive , Buccal, Mucoadhesive theories , Dosage form

3 INTRODUCTION:

Mucoadhesion has drawn a lot of attention in pharmaceutical technology since the early 1980s. Mucoadhesive systems have the potential to be used as drug carriers since they can increase contact with the epithelial barrier by extending their period of residence at the absorption site. A drug carrier system must be attached to a particular biological area in order for mucoadhesion, also known as bioadhesion, to occur. When a pressure-sensitive adhesive comes into contact with a surface (in this case, the mucus membrane), the two materials become adherent. Two Different forces that are further explicated in the mucoadhesion section hold these two surfaces together during the therapy time. Bioadhesion in biological systems can be categorized into three type;

1. Adhesion between two biological stages, such as platelet aggregation and wound healing.

2. Attachment of a biological phase to an artificial substrate, such as cell adhesion to culture dishes and biofilm development on prosthetic devices and inserts.

3. Attachment of a synthetic material to a biological substrate, such as the adherence of sealants to dental enamel and synthetic hydrogels to soft tissues.

Dosage forms designed for mucoadhesive drug delivery should be small and flexible enough to be acceptable for patients and should not cause irritation. Other desired characteristics of a mucoadhesive dosage form include high drug loading capacity, controlled drug release (preferably unidirectional release), good mucoadhesive properties, smooth surface, tastelessness, and convenient application. Several peptides, including thyrotropin-releasing hormone (TRH), insulin, octreotide, leuprolide, and oxytocin, have been delivered via the mucosal route, albeit with relatively low bioavailability (0.1–5%), owing to their hydrophilicity and large molecular weight, as well as the inherent permeation and enzymatic barriers of the mucosa.

The development of sustain release dosage form can achieve the aim of releasing the drug slowly for a long period but this is not sufficient to get sustained therapeutic effect. They may be cleared from the site of absorption before emptying the drug content. Instead, the mucoadhesive dosage form will serve both the purposes of sustain release and presence of dosage form at the site of absorption.

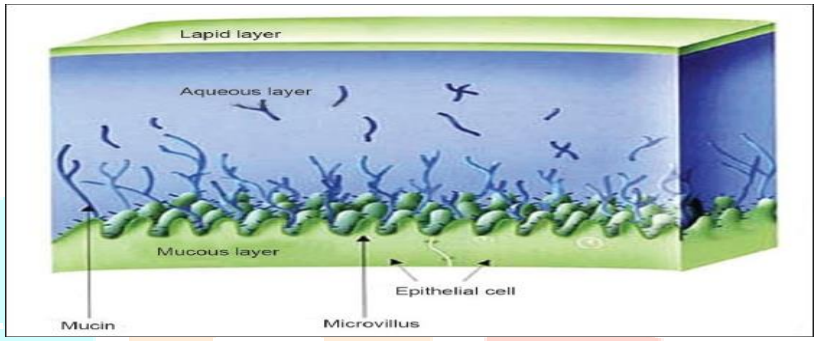
4 ADVANTAGES:

1. Prolonging the residence time of a dosage form at the site of absorption is a crucial strategy to enhance the bioavailability of drugs.
2. This product offers outstanding accessibility, ensuring its use is easy and convenient for all users. Its rapid onset of action guarantees quick and efficient results, making it an ideal choice for those seeking immediate relief or effects.
3. Due to a large blood supply and healthy blood flow rates, there is rapid absorption.
4. Due to the avoidance of first pass metabolism, medication bioavailability is rising.

5 DISADVANTAGES:

1. Due to prolonged interaction with a substance that has ulcer genic properties, localized consequences of ulcers may occur.
2. Lack of a suitable model for in vitro drug identification screening is one of the main obstacles to the development of oral mucosal administration. .ideal for such a management.
3. Patient acceptability is crucial when considering the taste and irritancy of medications or treatments. A pleasant taste can improve compliance, especially for oral medications, while minimizing irritancy helps reduce discomfort or adverse reactions.
4. Drinking and Eating are not permitted.

6 ABOUT MUCUS MEMBRANE:



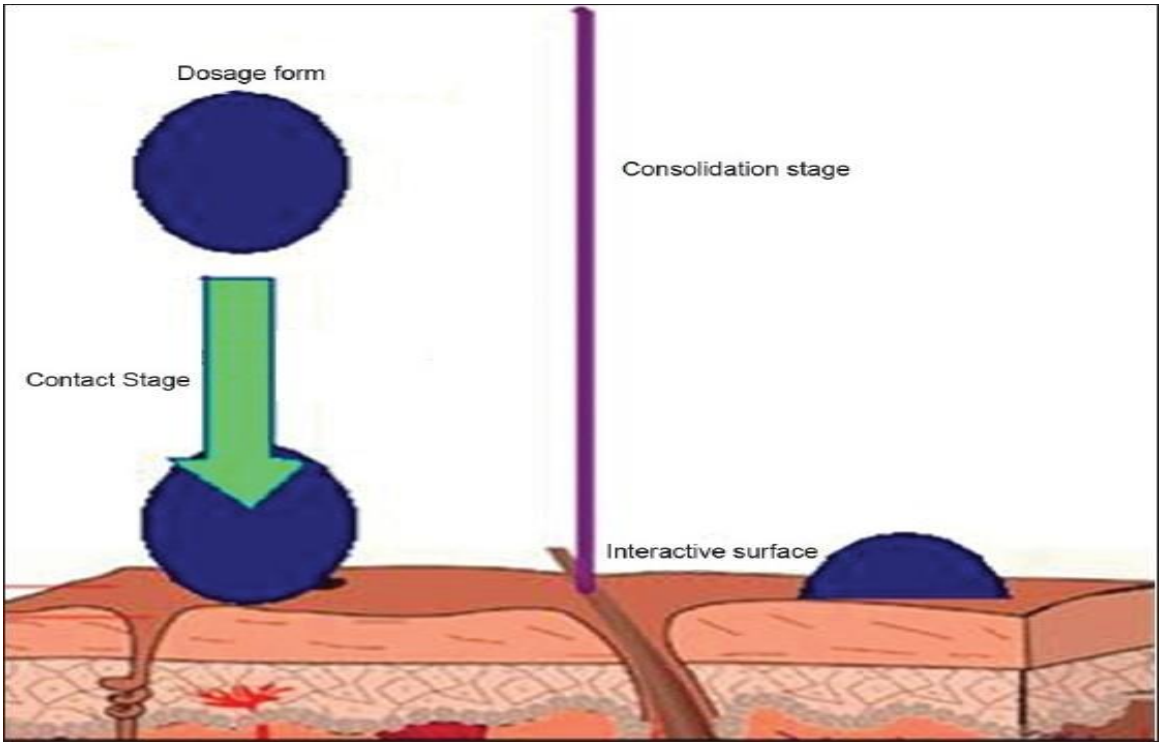
Mucus Membranes

Mucus membranes (mucosae) [Figure 1] are the moist surfaces lining the walls of various body cavities such as the gastrointestinal and respiratory tracts. They consist of a connective tissue layer (the lamina propria) above which is an epithelial layer, the surface of which is made moist usually by the presence of a mucus layer. The epithelia may be either single layered (e.g. the stomach, small and large intestines and bronchi) or multilayered/stratified (e.g. in the esophagus, vagina and cornea). The former contain goblet cells which secrete mucus directly onto the epithelial surfaces; the latter contain, or are adjacent to tissues containing, specialized glands such as salivary glands that secrete mucus onto the epithelial surface. Mucus is present either as a gel layer adherent to the mucosal surface or as a luminal soluble or suspended form. The major components of all mucus gels are mucin glycoproteins, lipids, inorganic salts and water, the latter accounting for more than 95% of their weight, making them a highly hydrated system.[5] The major functions of mucus are that of protection and lubrication.

7 MECHANISM OF MUCOADHESION:

An intriguing interfacial phenomenon known as mucoadhesion involves the joining of two different materials. The mucin layer found in mucosal tissues normally makes up one of these materials, whereas the other frequently consists of an artificial component like a mucoadhesive polymer. The attractive forces at the contact between these materials cause this adhesion to happen. It is just the mechanism by which these two substances adhere to one another. Any artificial substance that has the capacity to interact with mucous membranes the wet tissues that border the body's numerous organs, including the digestive tract, respiratory system, and others is referred to as a "mucoadhesive" These mucoadhesive materials are made to stick to these mucous membranes, which may cause them to be kept on the surface. Touch stage During this stage, an intimate wetting happens when the mucoadhesive material between the mucoadhesive comes into touch with the mucous membrane.mucous membrane, too. The mucus in the mucosal membrane wets the mucoadhesive, according to this statement. Consolidation stage: The mucoadhesive substance binds to the

mucous membrane through various physicochemical forces of attraction, creating a long-lasting mucoadhesion. This phase is referred to as consolidation. The mucoadhesion process is finished after these two phases.



MUCOADHESIVE THEORIES:

These theories include mechanical interlocking, electrostatic, diffusion interpenetration, adsorption and fracture processe.

1. WETTING THEORY:
The "spreadability" of an active drug delivery system is defined by the wettability hypothesis as the degree to which a mucoadhesive polymer may adhere to a biological membrane. The wetting theory relates to liquid systems that have an attraction for the surface and spread over it. This affinity can be discovered via measurement techniques. Such as the contact angle. This hypothesis is applicable for organizations with low viscosity or liquid mucoadhesive properties.

2. ADSORPTION THEORY: Adsorption theory established van der Waals' and hydrogen bond forces for adhesive contacts. After a first contact angle between the exteriors, the mucoadhesive material adheres due to superficial forces acting between the molecules of two surfaces. Collaboration through the contact occurs as a result of compact covalent bonding, according to the chemisorption idea.
3. FRACTURE THEORY: The strength necessary to distinguish both surfaces from each other, according to this approach, is linked to the bonding links between the systems. This "fracture theory" conveys polymer impartiality strength from mucus to the strength of their sticky bond.
4. DIFFUSION THEORY: This theory describes the time-dependent migration of mucoadhesive polymer chains into the mucus stratum's glycoprotein chain network, as seen in. This is a two-way diffusion approach in which permeation amount is determined by the diffusion coefficients of polymers that are mutually related. While many variables are considered in such operations, the essential qualities that have a significant impact on diffusion include cross-linking density, molecular weight, chain flexibility extension capacity of both networks, and temperature

5. MECHANICAL THEORY: According to mechanical theory, adhesion is caused by a mucoadhesive liquid filling the imperfections on a rough surface. Furthermore, roughness increases the interfacial area available to contacts, assisting in energy dissipation, and might be considered the most essential aspect of the process. The way adhesion happens isn't the same for everything. We have different ideas about how it works. These ideas help us figure out important things about how to make these systems

6. ELECTRONIC THEORY: Every surface possesses a distinctive electrical configuration and structural characteristics. This system relies on alterations in electronic arrangements or structures. It posits that bonding arises from the exchange of electrons between the polymer arrangement and the mucous membrane epithelium, leading to the formation of a double layer characterized by electric charges at the interface of the mucoadhesive system and the mucus. This phenomenon is responsible for generating attractive forces between the two surfaces through the electronic double layer.

8 FACTOR AFFECTING

1. FLEXIBILITY:

Mucoadhesion starts with the diffusion of the polymer chains in the interfacial region. Therefore, it is important that the polymer chains contain a substantial degree of flexibility in order to achieve the desired entanglement with the mucus.[11] The increased chain interpenetration was attributed to the increased structural flexibility of the polymer upon incorporation of polyethylene glycol.

2. CROSS LINKING DENSITY: The average pore size, the number and average molecular weight of the cross-linked polymers, and the density of cross-linking are three important and inter-related structural parameters of a polymer network.

3. HYDROGEN BONDING CAPACITY: Desired polymers must have functional groups that are able to form hydrogen bonds, and flexibility of the polymer is important to improve this hydrogen bonding potential.

4. MOLECULAR WEIGHT:

The mucoadhesive strength of a polymer increases with molecular weights above 100,000. Direct correlation between the mucoadhesive strength of polyoxyethylene polymers and their molecular weights lies in the range of 200,000–7,000,000.

9 SITE FOR MUCOADHESIVE DRUG DELIVERY SYSTEMS:

The common sites of application where mucoadhesive polymers have the ability to deliver pharmacologically active agents include oral cavity, eye conjunctiva, vagina, nasal cavity and GIT. The site provides an opportunity to deliver pharmacologically active agents systemically by avoiding hepatic first-pass metabolism in addition to the local treatment of the oral lesion. The sublingual mucosa is relatively more permeable than the buccal mucosa due to the presence of large number of smooth muscle and immobile mucosa. Hence, formulations for sublingual delivery are designed to release the active agent quickly while mucoadhesive formulation is of importance for the delivery of active agents to the buccal mucosa, where the active agent has to be released in a controlled manner. This makes the buccal cavity more suitable for mucoadhesive drug delivery.

The various mucoadhesive polymers used for the development of buccal delivery systems include cyanoacrylates, polyacrylic acid, sodium carboxymethylcellulose, hyaluronic acid, hydroxypropylcellulose, polycarbophil, chitosan and gellan. The delivery systems are generally coated with a drug and water impermeable film so as to prevent the washing of the active agent by the saliva.

1. Buccal Delivery System: An alternative to oral administration for medications affected by the first-pass effect is buccal drug delivery. Long regarded as an ideal location for medication administration, the stratified squamous epithelium in the buccal mucosa is supported by connective tissue lamina propria. Buccal

administration has benefits including simple accessibility, epithelial resilience, flexible dose, and decreased vulnerability to enzymatic activity. As a result, oral administration systems for sticky mucosal dosage forms, including adhesive tablets, gels, and patches, have been created. The development of efficient bio adhesive buccal delivery methods, however, still faces a major issue with the absorption of hydrophilic medicines through the membrane.

2. Oral Delivery System: The goal of a system created for oral drug administration is to provide consistent drug release as the patient's digestive system moves through it. Even while oral delivery is popular and well-liked by patients, it has challenges because of interactions with the gastrointestinal system and drug effectiveness. A lot of research has been done on lipid-based oral delivery systems, with a focus on how each system component affects delivery effectiveness and the route of lipid-based oral administration.

3. Vaginal Delivery System: The uterus is connected to the outside of the body by the vagina, which acts as a fibrovascular conduit. Lamina propria and squamous epithelium are used to line it. There are many other dose forms that can be used for vaginal administration, including solutions, gels, suspensions, suppositories, creams, and tablets, although they usually only stay in the vagina for a short time. Bioadhesive compounds can extend the shelf life of vaginal formulations and control the rate of medication release. To treat vaginal dryness, these formulations may contain medication or even work in conjunction with moisturizers.

4. Rectal Delivery System: A section of the colon called the rectum has a surface area of 300 cm2 and a length of around 10 cm. Its main function is to remove water. Its surface area for medication absorption is considerably constrained due to the lack of villi. The rectum primarily absorbs drugs through simple diffusion over the lipid membrane. Rectal administration offers significant benefits for substances that are prone to significant first-pass metabolism, especially when administered to areas close to the anus. Additionally, it has been noted that the migration distance within the rectum is reduced by the addition of bioadhesive polymers.

5. Nasal Delivery System: Nasal administration, commonly referred to as snorting, is a method of delivering drugs by inhaling them through the nose.1) Utilization of nasal tablets for local drug delivery 2) Achieving systemic drug delivery 3) Transporting drugs from the nose to the brain 4) Delivery of nasal vaccines.

6. Ocular Delivery System: Ocular Delivery System: Nasal administration, commonly referred to as snorting, is a method of delivering drugs by inhaling them through the nose. Furthermore, factors such as the nasal floor, drug concentration and amount, the physical state of the dosage form, and the positioning of the head during administration all contribute to the drug absorption process. This route of administration encompasses several applications: The eye is a sophisticated organ that has unique anatomical and physiological characteristics. A unique drug delivery technique includes injecting the medication into the ODDS, also known as the conjunctival cavity of the eye. A specialized, sterile method of creating dosage forms is called ophthalmic preparation. Drugs can be administered intravenously for intraocular therapies, topically for topical treatments, or next to the eye for periocular treatments.

7. Gastrointestinal Delivery System: The oral route is undoubtedly the most desired way of administration, but there are some serious risks with it, including hepatic first-pass metabolism, drug degradation during absorption, the presence of mucus on GI epithelia, and rapid mucus turnover. Delivery through the gastrointestinal tract (GIT) has been more well-known recently as a major administration route. Systems that use bio adhesive polymers to adhere to the epithelial surface in the GIT are called bio adhesive retentive systems. The use of bio adhesive polymers can prolong GI transit time and increase bioavailability.

10 MUCOADHESIVE DOSAGE FORM:

1. PATHCES: Patches are laminates consisting of an impermeable backing layer, a drug-containing reservoir layer from which the drug is released in a controlled manner, and a mucoadhesive surface for mucosal attachment. Patch systems are similar to those used in transdermal drug delivery. Two methods used to prepare adhesive patches include solvent casting and direct milling. In the solvent casting method, the intermediate sheet from which patches are punched is prepared by casting the solution of the drug and polymer(s) onto a backing layer sheet, and subsequently allowing the solvent(s) to evaporate.
2. TABLETS: Mucoadhesive tablets, in general, have the potential to be used for controlled release drug delivery, but coupling of mucoadhesive properties to tablet has additional advantages, for example, it offers efficient absorption and enhanced bioavailability of the drugs due to a high surface to volume ratio and facilitates a much more intimate contact with the mucus layer. Mucoadhesive tablets can be tailored to adhere to any mucosal tissue including those found in stomach, thus offering the possibilities of localized as well as systemic controlled release of drugs. The application of mucoadhesive tablets to the mucosal tissues of gastric epithelium is used for administration of drugs for localized action.
3. FILMS: Mucoadhesive films may be preferred over adhesive tablets in t An ideal film should be flexible, elastic, and soft, yet adequately strong to withstand breakage due to stress from mouth movements. It must also possess good mucoadhesive strength in order to be retained in the mouth for the desired duration of action. Swelling of film, if it occurs, should not be too extensive in order to prevent discomfort.erms of flexibility and comfort.
4. GELS AND OINYMENTS: Semisolid dosage forms, such as gels and ointments, have the advantage of easy dispersion throughout the oral mucosa. However, drug dosing from semisolid dosage forms may not be as accurate as from tablets, patches, or films. Poor retention of the gels at the site of application has been overcome by using mucoadhesive formulations.

Certain mucoadhesive polymers, for example, sodium carboxymethylcellulose, carbopol, hyaluronic acid, and xanthan gum, undergo a phase change from liquid to semisolid. This change enhances the viscosity, which results in sustained and controlled release of drugs. Hydrogels are also a promising dosage form for buccal drug delivery. They are formed from polymers that are hydrated in an aqueous environment and physically entrap drug molecules for subsequent slow release by diffusion or erosion.

CONCLUSION:

In conclusion, mucoadhesive systems have become a potential approach in pharmaceutical technology for improving drug delivery. These systems use specific polymers to stick to mucosal membranes, increasing medication residence duration and enhancing absorption. They come with benefits like improved bioavailability, patient compliance, and tailored distribution, but they also have drawbacks including potential side effects and in vitro testing. The commercial use of mucoadhesive polymers in diverse medication delivery methods highlights their usefulness. This novel method of drug delivery has enormous potential to revolutionize healthcare and improve treatment results.

REFERENCES:

1.Boddupalli, B. M., Mohammed, Z. N., Nath, R. A., & Banji, D. (2010). Mucoadhesive drug delivery system: An overview. Journal of Advanced Pharmaceutical Technology & Research, 1(4), 381-387. https://doi.org/10.4103/0110-5558.76436

2. https://doi.org/10.1590/S1984-82502010000100002citedon22/07/2023

3. Komati, S., Swain, S., Rao, M. E. B., Jena, B. R., & Dasi, V. (2019). Mucoadhesive Multiparticulate Drug Delivery Systems: An Extensive Review of Patents. Advances in Pharmaceutical Bulletin, 9(4), 521-538. DOI: 10.15171/apb.2019.062

4. Shaikh, R., Raj Singh, T. R., Garland, M. J., Woolfson, A. D., & Donnelly, R. F. (2011). Mucoadhesive Drug Delivery Systems. Journal of Pharmaceutical and Bioallied Sciences, 3(1), 89-100. DOI: 10.4103/0975-7406.76478

5. Chowdary, K. P. R., & Srinivasa, R. Y. (2003). AAPS PharmSci Tech, 4.

6. Choudary, K. P. R., & Srinivas, L. (2000). Indian Drugs, 37(9), 400.

- 7. Kamath, K. R., & Park, K. (1994). Mucosal Adhesive Preparations. In Encyclopedia of Pharmaceutical Technology (1st Ed., Vol. 10, pp. 133). Marcel Dekker. 8.Kinloch AJ. The science of adhesion. J Mater Sci. 1980;15:2141–66. [Google Scholar]

- 9.Jiménez-Castellanos MR, Zia H, Rhodes CT. Mucoadhe-sive drug delivery systems. Drug Dev Ind Pharm. 1993;19:143–94. [Google Scholar]

- 10.Tiwari D, Goldman D, Sause R, Madan PL. Evaluation of polyoxyethylene homopolymers for buccal bioadhesive drug delivery device formulations. AAPS Pharm Sci. 1999;1:13–21. doi: 10.1208/ps010313. [DOI] [PMC free article] [PubMed] [Google Scholar]