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DEVELOPMENT AND EVALUATION OF MUCOADHESIVE BUCCAL TABLETS OF ONDANSETRON FOR BUCCAL DRUG DELIVERY

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ABSTRACT:

Ondansetron is a widely used antiemetic drug for the prevention and treatment of chemotherapy-induced, radiotherapy-induced, and postoperative nausea and vomiting. However, its oral administration is associated with limitations such as first-pass hepatic metabolism, gastrointestinal degradation, and reduced effectiveness in patients experiencing nausea, vomiting, or swallowing difficulties Buccal drug delivery offers a promising alternative route by enabling direct absorption of the drug through the buccal mucosa into the systemic circulation, thereby bypassing hepatic first-pass metabolism and improving bioavailability. The present review focuses on the development and evaluation of mucoadhesive buccal tablets of ondansetron as an effective drug delivery system. The anatomy and physiology of the buccal mucosa, including its structure, permeability, blood supply, and the role of saliva, are discussed in relation to drug absorption.Special emphasis is placed on the concept of mucoadhesion, its mechanisms, theories, and the role of various mucoadhesive polymers such as Hydroxypropyl Methylcellulose (HPMC), Carbopol, Sodium Carboxymethyl Cellulose (Sodium CMC), Sodium Alginate, and Chitosan in enhancing residence time and drug release The review also highlights different buccal dosage forms, methods of preparation, formulation components, and evaluation parameters including pre-compression studies, post-compression characteristics, mucoadhesive strength, swelling index, drug content uniformity, ex-vivo residence time, and in-vitro drug release studies Furthermore, the applications of mucoadhesive buccal tablets in paediatric and geriatric patients, emergency antiemetic therapy, and patients with dysphagia are explored. Future

prospects involving permeation enhancers, patient-centered formulation design, and regulatory considerations are also discussed. Overall, mucoadhesive buccal tablets of ondansetron represent a promising and patient-friendly drug delivery approach capable of improving therapeutic efficacy, enhancing bioavailability, and providing rapid onset of antiemetic action. The continued advancement of buccal drug delivery technology may contribute significantly to the development of more effective and convenient antiemetic therapies.

KEYWORDS: Buccal drug delivery; Mucoadhesion; Ondansetron; Bioadhesive polymers; First-pass metabolism; Controlled release; Antiemetic.

INTRODUCTION

Limitations of Oral Drug Delivery

The oral route is the most commonly used method of drug administration because it is convenient, non-invasive, and widely accepted by patients.[1,8] However, many drugs show poor bioavailability when administered orally due to extensive first-pass metabolism in the liver and degradation in the gastrointestinal tract.[2,3] Factors such as gastric acid, digestive enzymes, and variable gastrointestinal conditions can reduce drug absorption and therapeutic effectiveness.[14] In addition, oral administration may not be suitable for patients suffering from dysphagia, nausea, vomiting, or unconsciousness.[4,17] These limitations have led to the development of alternative drug delivery systems that can improve drug absorption and bypass first-pass metabolism.[16,50]

Concept of Buccal Drug Delivery System (BDDS)

Buccal drug delivery refers to the administration of drugs through the buccal mucosa, the inner lining of the cheek, to achieve local or systemic therapeutic effects.[3,16] Drugs absorbed through the buccal mucosa enter the systemic circulation directly via the rich blood supply, thereby avoiding hepatic first-pass metabolism and gastrointestinal degradation.[4,6] Buccal drug delivery systems include mucoadhesive tablets, patches, films, gels, and other formulations designed to remain in contact with the mucosal surface for an extended period.[5,19] Among these, mucoadhesive buccal tablets are particularly attractive due to their ease of formulation, prolonged residence time, improved bioavailability, and enhanced patient compliance.[7,18] These advantages make buccal drug delivery a promising approach for drugs requiring rapid and efficient systemic absorption.[50]

Anatomy and Physiology of the Buccal Mucosa:

Structure

The buccal mucosa is the inner lining of the cheek and consists of a non-keratinized stratified squamous epithelium.[14,15] It is mainly composed of three layers: the epithelium, basement membrane, and the underlying lamina propria with submucosa. The epithelium is approximately 500–600 µm thick and is made up of several layers of cells.[6,16] Unlike the keratinized tissues of the palate and gingiva, the buccal mucosa lacks a stratum corneum, making it more permeable to drug molecules.[3,4] The lamina propria and submucosa contain connective tissues, blood vessels, nerves, and minor salivary glands, providing flexibility and support to the buccal tissue.[15]

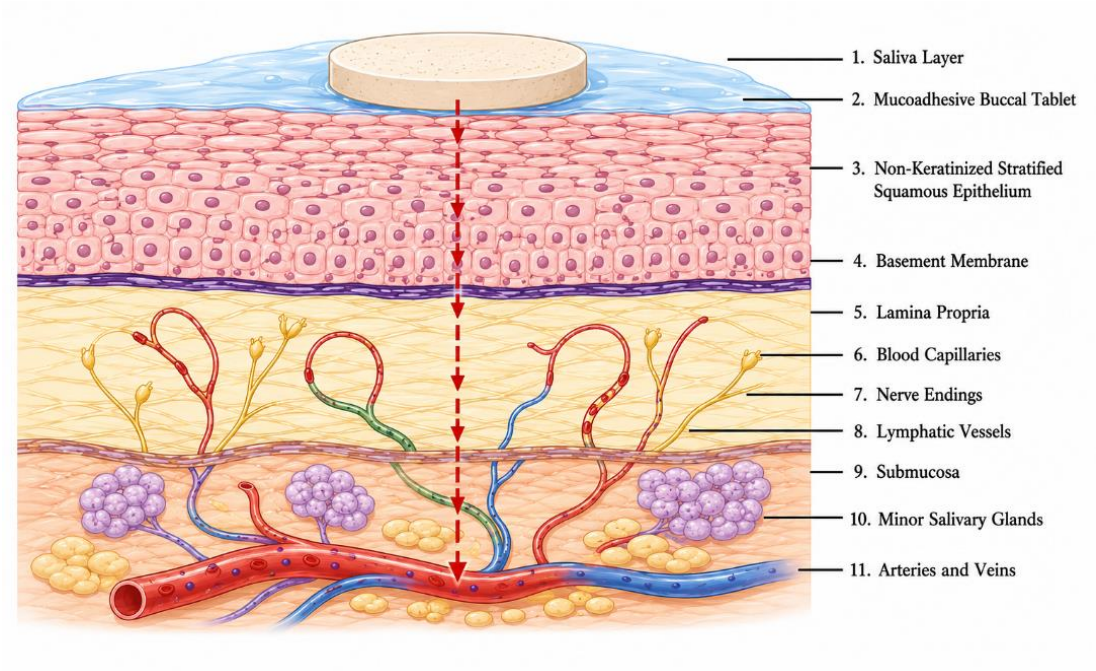

Figure 1: Anatomical Structure of the Human Buccal Mucosa.

Permeability and Blood Supply

The buccal mucosa acts as an effective barrier while allowing the absorption of drugs. Drug permeation occurs through both transcellular and paracellular pathways.[3,6] Due to its moderate permeability, the buccal mucosa offers a suitable site for systemic drug delivery.[4,16] The region is highly vascularized and receives blood supply from the facial, maxillary, and lingual arteries. Drugs absorbed through the buccal mucosa enter the systemic circulation directly through the venous drainage system, thereby avoiding hepatic first-pass metabolism and improving bioavailability.[14,50]

Saliva and Its Role

Saliva plays a vital role in buccal drug delivery. It continuously moistens the oral cavity, maintains the integrity of the mucosal surface, and facilitates the hydration and swelling of mucoadhesive polymers.[15,16] Saliva also helps in the dissolution and release of drugs from buccal formulations.[5] However, continuous saliva secretion and swallowing may remove the drug or dosage form from the site of administration before complete absorption occurs.[6,20] Therefore, buccal formulations should possess adequate mucoadhesive strength and controlled drug release properties to ensure effective drug absorption and prolonged residence time in the oral cavity.[19,21]

Drug Profile: Ondansetron

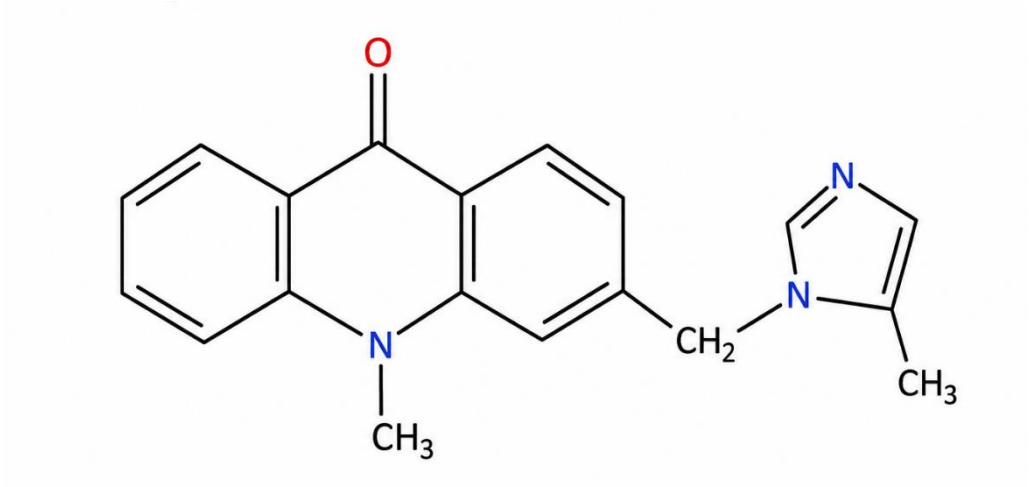

Figure 2: Chemical Structure of Ondansetron.

Chemical Structure, Molecular Formula and Molecular Weight

Ondansetron is chemically described as 1,2,3,9-tetrahydro-9-methyl-3-[(2-methyl-1H-imidazol-1-yl)methyl]-4H-carbazol-4-one.[22,27] It is most commonly formulated and studied as the hydrochloride dihydrate salt, ondansetron hydrochloride dihydrate, for pharmaceutical use. The molecular formula of the free base is $C_{18}H_{19}N_3O$, corresponding to a molecular weight of approximately 293.4 g/mol; the hydrochloride dihydrate salt has a molecular weight of approximately 365.9 g/mol.[22] Structurally, the molecule contains a carbazolone ring system linked to a methylimidazole moiety, a configuration that confers high affinity and selectivity for the 5-HT_3 (serotonin type 3) receptor subtype.[23,25]

Physicochemical Properties

Table 1: Summary of physicochemical properties of ondansetron relevant to buccal formulation design.

Property	Characteristic
Appearance	White to off-white crystalline powder
Solubility	Slightly soluble in water; sparingly soluble in alcohol; solubility of the hydrochloride salt is markedly higher than the free base
pKa	Approximately 7.4 (imidazole nitrogen), rendering the molecule predominantly ionised at acidic pH and increasingly unionised as pH rises toward and beyond the salivary/buccal pH range
Melting point	Approximately 178–180°C for the hydrochloride dihydrate form
Partition coefficient (log P)	Moderately lipophilic (reported log P values generally in the range of 1.5–2.5 for the free base), consistent with reasonable passive transcellular permeability
Stability	Susceptible to photodegradation and to degradation under strongly acidic or alkaline conditions; generally stable under recommended storage conditions

Mechanism of Action

Ondansetron is a selective and competitive antagonist at the 5-hydroxytryptamine type 3 (5-HT_3) receptor.[23,24] These receptors are located both peripherally, on vagal and splanchnic afferent nerve terminals within the gastrointestinal tract, and centrally, within the chemoreceptor trigger zone of the area postrema and the nucleus tractus solitarius in the brainstem.[1,25] Chemotherapeutic agents, radiotherapy, and surgical anaesthesia are each capable of provoking the release of serotonin from enterochromaffin cells of the small intestine; this released serotonin activates 5-HT_3 receptors on vagal afferents, initiating the reflex arc responsible for the vomiting response.[24,26] By blocking 5-HT_3 receptors at both peripheral and central sites, ondansetron interrupts this reflex, providing effective prophylaxis and treatment of chemotherapy-induced, radiotherapy-induced, and postoperative nausea and vomiting.[22,25]

Therapeutic Uses:

1. Prevention and treatment of chemotherapy-induced nausea and vomiting (CINV), including both acute and delayed phases.[22,24,25]
2. Prevention and treatment of radiotherapy-induced nausea and vomiting (RINV), particularly with total body or upper abdominal irradiation.[22,24]
3. Prevention and treatment of postoperative nausea and vomiting (PONV) following surgery and general anaesthesia.[22,26]
4. Off-label and adjunctive use in selected cases of gastroenteritis-associated vomiting and hyperemesis, under clinical supervision.[23]

Mucoadhesion: Theoretical Background

Definition and Concept of Bioadhesion/Mucoadhesion

Bioadhesion is the attachment of a material to a biological surface for a prolonged period.[36,37] When this attachment occurs between a polymer and the mucus layer covering a mucosal surface, it is known as mucoadhesion.[20,30] In buccal drug delivery, mucoadhesion helps the dosage form remain at the site of application, improving drug absorption and reducing loss due to saliva and swallowing.[6,21]

Structure and Composition of the Mucus Layer:

The mucus layer covering the buccal mucosa is mainly composed of water, mucin glycoproteins, salts, enzymes, and lipids.[12,20] Mucin glycoproteins possess a negative charge and form a gel-like structure that allows mucoadhesive polymers to interact through hydrogen bonding and other intermolecular forces.[34,39]

Theories of Mucoadhesion:

Several theories have been proposed to explain mucoadhesion.[36,37,38] The Electronic Theory suggests that adhesion occurs due to electron transfer and electrostatic attraction between polymer and mucus. The Adsorption Theory attributes adhesion to secondary bonds such as hydrogen bonds and van der Waals forces. The Wetting Theory explains adhesion based on the ability of the polymer to spread over the mucosal surface. The Diffusion Theory proposes interpenetration of polymer and mucin chains, forming a strong adhesive bond. The Fracture Theory relates mucoadhesion to the force required to separate the polymer from the mucosal surface.[38,39]

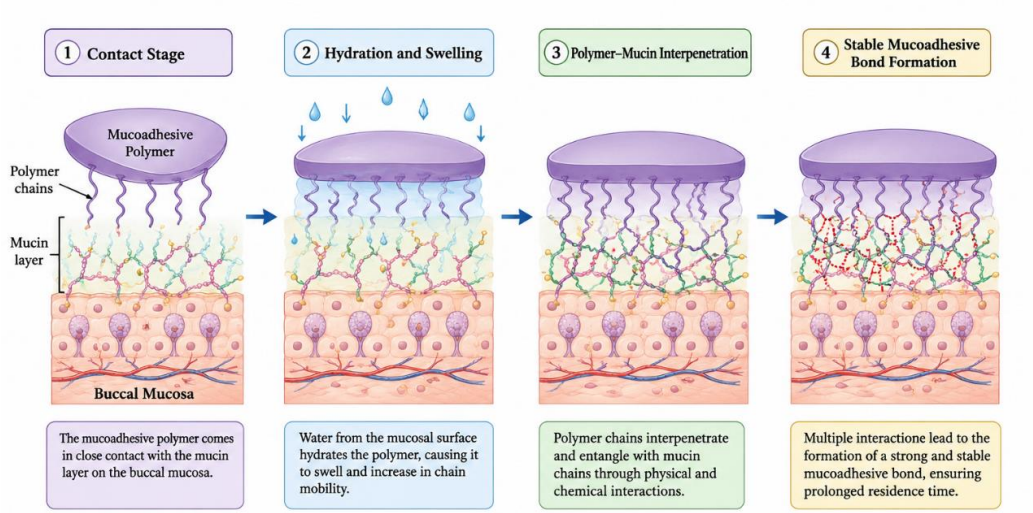

Figure 3: Schematic Representation of the Mechanism of Mucoadhesion.

Mechanism of Mucoadhesion:

Mucoadhesion generally occurs in two stages.[20,36] During the Contact Stage, the dosage form comes into contact with the mucosal surface and begins to hydrate and swell. In the Consolidation Stage, polymer chains interpenetrate with mucin chains and form secondary bonds, resulting in a stable mucoadhesive interaction.[37,39]

Mucoadhesive Polymers:

Classification of Mucoadhesive Polymers

A. Natural Polymers: Chitosan, Sodium Alginate, Guar Gum, Xanthan Gum, Gelatin.[31,32,33]

B. Semi-Synthetic Polymers: Hydroxypropyl Methylcellulose (HPMC), Carboxymethyl Cellulose (CMC), Hydroxypropyl Cellulose (HPC), Hydroxyethyl Cellulose (HEC).[6,30]

C. Synthetic Polymers: Carbopol (Carbomer), Polyvinylpyrrolidone (PVP), Polyethylene Oxide (PEO).[34,35]

Ideal Properties of Mucoadhesive Polymers:

An ideal mucoadhesive polymer should be non-toxic, non-irritating, and biocompatible with the buccal mucosa.[29,30] It should possess good mucoadhesive strength, adequate swelling capacity, and the ability to provide controlled drug release. Additionally, it should be stable, cost-effective, easy to process during tablet manufacturing, and capable of maintaining adhesion for the desired period without causing discomfort to the patient.[6,21]

Selection Criteria for Buccal Tablet Formulation:

The selection of mucoadhesive polymers depends on the desired residence time, drug release profile, swelling behavior, and compatibility with the drug.[6,29] For Ondansetron buccal tablets, polymers such as HPMC, Carbopol, sodium alginate, and sodium CMC are commonly used because they provide good mucoadhesion and controlled drug release.[7,18] Often, combinations of polymers are employed to achieve an optimum balance between adhesion strength and therapeutic effectiveness.[21,30]

Buccal Tablet Dosage Forms:

Types of Buccal Drug Delivery Systems

Several distinct dosage-form platforms have been developed for buccal drug delivery, each presenting a different balance of manufacturing complexity, patient acceptability, and control over drug release.[4,5,10]

Table 2: Comparison of buccal drug delivery system types.

Dosage Form	Key Characteristics
Buccal tablets	Compressed, often multilayered, solid dosage forms; well-established manufacturing technology; precise dosing; can be designed for unidirectional release
Buccal patches	Laminated, flexible systems typically comprising a drug-polymer matrix layer and an impermeable backing layer; thinner and often more comfortable than tablets
Buccal films	Thin, flexible polymeric films prepared by solvent casting or hot-melt extrusion; rapid hydration and good patient comfort, but lower drug loading capacity
Buccal gels	Semi-solid systems offering ease of application, particularly for localized therapy, but generally poorer dose precision and shorter retention than solid dosage forms
Buccal microspheres/nanoparticles	Particulate carriers offering increased surface area and, in some cases, improved mucoadhesion and controlled release

Types of Buccal Tablets:

Matrix-Type Tablets

Matrix-type buccal tablets consist of a single, homogeneous compressed layer in which the drug, mucoadhesive polymer(s), and other excipients are uniformly distributed throughout the tablet mass.[7,8] Drug release from a matrix tablet may be uni-directional or bi-directional. Uni-directional release is generally preferred for systemically absorbed drugs such as ondansetron, since it concentrates drug release at the absorption surface and reduces the fraction of dose lost through swallowing of saliva-dissolved drug.[16,19]

Reservoir/Multilayer Tablets

Reservoir or multilayer buccal tablets are constructed with at least two distinct layers: a drug-containing mucoadhesive layer, which faces and adheres to the buccal mucosa, and a backing layer composed of a water-impermeable polymer (commonly ethyl cellulose), which faces the oral cavity.[18,19] The backing layer serves to direct drug release unidirectionally toward the mucosa, to protect the drug-containing layer from premature dissolution by saliva, and, in some designs, to provide a degree of mechanical protection and improved patient comfort.[7,21]

Methods of Preparation:

Direct Compression

Direct compression is the most commonly reported method for preparing mucoadhesive buccal tablets of ondansetron and similar small-molecule drugs.[7,8,9] In this method, the drug, mucoadhesive polymer(s), diluent, and other excipients are dry-blended in the required proportions, typically following geometric dilution to ensure uniform drug distribution, and the resulting blend is directly compressed using a tablet press.[8] Direct compression is

favoured for its operational simplicity, reduced processing time, and avoidance of heat and moisture exposure that could compromise drug or polymer stability.[9,17]

Wet Granulation

Wet granulation may be employed where the powder blend exhibits poor flow or compressibility for direct compression, or where improved tablet hardness and reduced friability are required.[8,9] In this method, the drug and polymer blend is granulated using a suitable binder solution (commonly an aqueous or hydroalcoholic solution of PVP or a portion of the mucoadhesive polymer itself), the resulting wet mass is passed through a sieve to form granules, dried to the desired moisture content, and subsequently blended with extragranular excipients prior to compression.[8,17]

Solvent Casting (For Comparison with Films)

Although not applicable to tablet manufacture itself, solvent casting is frequently discussed in the buccal delivery literature as the principal method for preparing buccal films.[10,11] In solvent casting, the polymer(s) and drug are dissolved or dispersed in a suitable solvent system, cast onto a levelled surface, and dried under controlled conditions to form a thin film, which is subsequently cut into individual dosage units.[5,10] Comparative studies generally find that tablets offer more precise dosing and easier large-scale manufacture, while films offer greater patient comfort and more rapid hydration.[10]

Formulation Components:

Mucoadhesive Polymers

The mucoadhesive polymer (or combination of polymers) forms the functional core of the buccal tablet, governing both adhesion to the mucosa and the rate of drug release through swelling, gelation, and erosion behaviour.[6,29,30]

Diluents/Fillers

Diluents such as microcrystalline cellulose, lactose, and mannitol are incorporated to achieve a practical tablet weight and to improve powder flow and compressibility, particularly when the dose of active drug is small, as is generally the case for ondansetron.[8,9] Mannitol is frequently favoured in orally and buccally administered formulations for its pleasant taste and low hygroscopicity.[8]

Permeation Enhancers

Because the buccal epithelium, while more permeable than keratinised oral tissue, still presents a significant barrier to drug absorption, permeation enhancers are frequently incorporated to improve the flux of drug across the mucosa.[13,16] Commonly studied permeation enhancers in buccal formulations include surfactants (such as sodium lauryl sulfate and bile salts), fatty acids and their esters (such as oleic acid), chelating agents (such as EDTA), and cyclodextrins.[13,44] For ondansetron, the inclusion of a permeation enhancer is considered primarily on a case-by-case basis, weighed against the potential for the enhancer to cause local mucosal irritation with repeated use.[44]

Backing Membrane Materials

Where a reservoir or multilayer design is used, the backing layer is typically composed of a water-insoluble polymer such as ethyl cellulose, sometimes in combination with a plasticiser to achieve the desired flexibility, to ensure that the layer remains intact and impermeable throughout the intended residence time of the tablet.[7,19]

Sweetening/Flavouring Agents

Given that the buccal tablet resides within the oral cavity for an extended period, palatability is an important determinant of patient acceptance and compliance.[17,18] Sweetening agents (such as mannitol, sucralose, or aspartame) and flavouring agents (such as mint or fruit flavours) are commonly incorporated to mask any bitter taste associated with the drug or polymer and to improve the overall sensory experience.[9,17]

Lubricants and Glidants

Lubricants such as magnesium stearate and glidants such as talc or colloidal silicon dioxide are included at low concentrations to improve powder flow during compression and to reduce friction between the tablet and the punch/die surfaces, facilitating efficient ejection and reducing the risk of sticking or capping.[8,9]

Evaluation Parameters for Mucoadhesive Buccal Tablets:

Pre-Compression Parameters

Pre-compression evaluation of the powder blend is essential to predict and ensure consistent tablet weight, content uniformity, and mechanical quality during compression.[8,40]

Table 3: Pre-compression (powder flow) parameters routinely evaluated for buccal tablet blends.

Parameter	Method / Significance
Bulk density	Mass of powder divided by the untapped (bulk) volume it occupies; reflects the loosely packed state of the powder
Tapped density	Mass of powder divided by the volume after a defined number of mechanical taps; reflects the most closely packed state achievable without compression
Angle of repose	Angle formed by a freely poured powder heap with the horizontal plane; lower angles (typically <30°) indicate better flow
Carr's index	Calculated from bulk and tapped density as [(Tapped − Bulk)/Tapped] × 100; lower values indicate better flowability
Hausner's ratio	Calculated as Tapped density / Bulk density; values closer to 1.0 indicate better flow, while values above ~1.25 suggest poor flow

Post-Compression / Physicochemical Parameters:

Surface pH

Surface pH is determined by allowing the tablet to swell in contact with a small volume of distilled water or simulated salivary fluid for a defined period and measuring the pH at the tablet surface.[42,43] The surface pH should ideally be close to the physiological pH of saliva (approximately 6.5–7.0) in order to minimise the risk of mucosal irritation.[14,44]

Swelling Index

The swelling index is determined by weighing a tablet before immersion in a suitable medium (commonly phosphate buffer at salivary pH), removing it at predetermined time intervals, gently removing excess surface liquid, and re-weighing; the percentage increase in weight relative to the initial weight is calculated and plotted against time.[7,18,43] The swelling index provides important information on the rate and extent of hydration of the mucoadhesive matrix, which directly influences both the kinetics of mucoadhesive bond formation and the mechanism of drug release.[6,21]

Mucoadhesive Strength / Force of Adhesion

Mucoadhesive strength is most commonly measured using a modified physical balance or a texture analyser fitted with a mucoadhesion test rig, in which the buccal tablet is brought into contact with a section of mucosal tissue under a standard contact time and force, and the force required to detach the tablet from the mucosal surface is recorded.[42,43] This detachment force, divided by the area of contact, is reported as the mucoadhesive strength (often in dynes/cm² or N/cm²) or the work of adhesion can be calculated from the area under the force-distance curve.[20,42]

Ex-Vivo Residence Time

Ex-vivo residence time is evaluated using an apparatus designed to simulate the conditions of the buccal cavity, typically consisting of a section of excised mucosal tissue mounted within a flow-through or paddle-type apparatus through which a simulated salivary fluid is circulated at a controlled flow rate and temperature (37°C).[7,43,48] The time taken for the tablet to detach completely or to erode/dissolve is recorded, providing a practical surrogate measure of how long the formulation would be expected to remain in place in vivo.[42,48]

Drug Release Studies:

In-Vitro Drug Release (Modified USP Apparatus)

In-vitro drug release from mucoadhesive buccal tablets is typically conducted using a modified USP dissolution apparatus, most often a modified USP Type II (paddle) apparatus in which the tablet is affixed to a glass slide or disc positioned at the bottom of the dissolution vessel to simulate unidirectional release toward the mucosa.[7,43,45] The dissolution medium is generally a small volume of simulated salivary fluid or phosphate buffer at salivary pH, maintained at 37°C, with samples withdrawn at predetermined time intervals and assayed (typically by UV spectrophotometry) for ondansetron content.[7,40]

Release Kinetics

The dissolution data obtained from in-vitro release studies are fitted to established mathematical models to characterise the mechanism and order of drug release from the mucoadhesive matrix.[45,46,47]

Table 4: Mathematical models commonly applied to interpret drug release kinetics from mucoadhesive buccal tablets.

Kinetic Model	Equation / Basis	Interpretation
Zero-order	$Qt = Q_0 + K_0t$	Drug release rate is independent of concentration; ideal for sustained, constant-rate release
First-order	$\log Qt = \log Q_0 - K_1t/2.303$	Drug release rate is proportional to the remaining drug concentration in the matrix
Higuchi model	$Qt = Kh\sqrt{t}$	Drug release is diffusion-controlled from a swellable/insoluble matrix, proportional to the square root of time
Korsmeyer-Peppas model	$Mt/M\infty = Kpt^n$	The release exponent 'n' indicates the mechanism: $n \leq 0.45$ = Fickian diffusion; $0.45 < n < 0.89$ = anomalous transport; $n \geq 0.89$ = case-II transport

The model that provides the best fit to the experimental release data, together with the value of the release exponent 'n' obtained from the Korsmeyer-Peppas model, is used to draw

conclusions about the dominant drug release mechanism (diffusion through the swollen polymer matrix, polymer chain relaxation/erosion, or a combination of both) operating in a given formulation.[46,47]

Ex-Vivo/In-Vivo Permeation Studies:

Porcine/Sheep Buccal Mucosa Models

Ex-vivo permeation studies are most commonly conducted using excised porcine or sheep buccal mucosa, both of which are widely accepted as reasonable structural and functional surrogates for human buccal tissue owing to similarities in epithelial thickness and lipid composition.[48,49] The excised mucosal tissue is mounted in a Franz diffusion cell, with the buccal tablet placed in the donor compartment in contact with the mucosal (epithelial) surface and a suitable receptor medium, generally phosphate buffer maintained at 37°C.[42,48] Samples are withdrawn from the receptor compartment at predetermined intervals and assayed for drug content, allowing calculation of cumulative drug permeated, flux, and apparent permeability coefficient across the mucosal barrier.[48]

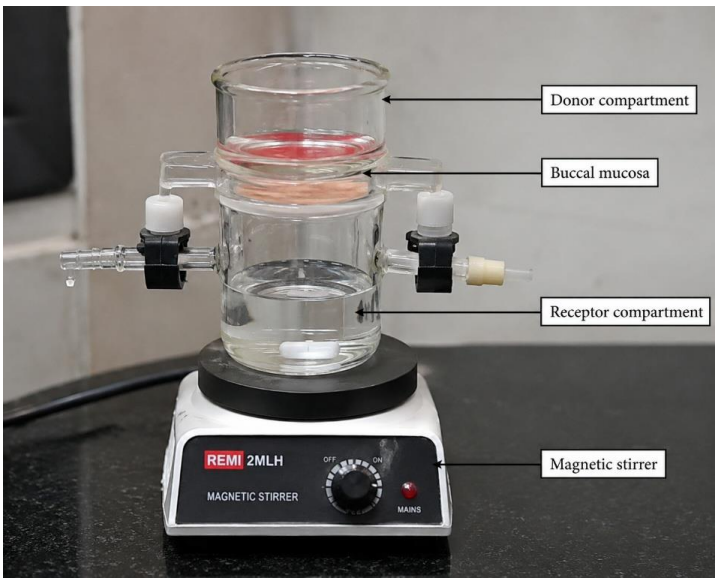

Figure 4: Franz Diffusion Cell Setup for Ex-vivo Buccal Permeation Study.

Effect of Permeation Enhancers

Where a permeation enhancer is included in the formulation, comparative ex-vivo permeation studies (with and without the enhancer, or across a range of enhancer concentrations) are conducted to quantify the enhancement ratio — typically expressed as the fold-increase in flux or permeability coefficient relative to the unenhanced formulation.[13,44] Histopathological examination of the exposed tissue is often undertaken to confirm that the

chosen enhancer concentration improves permeation without causing unacceptable mucosal damage.[44,49]

Applications of Mucoadhesive Buccal Tablets:

Paediatric and Geriatric Patients

Mucoadhesive buccal tablets are particularly useful for paediatric and geriatric patients who often experience difficulty swallowing conventional tablets and capsules.[17,18] The buccal route improves patient convenience and compliance while reducing the risk of choking and swallowing-related complications.[4,16]

Emergency and Rapid-Onset Antiemetic Therapy

Buccal delivery is highly beneficial in conditions requiring rapid antiemetic action, such as chemotherapy-induced nausea and vomiting, postoperative nausea, and acute gastroenteritis.[22,24,25] Since drug absorption occurs directly through the buccal mucosa, a faster onset of action can be achieved compared to conventional oral dosage forms.[3,7]

Patients with Dysphagia or Persistent Vomiting

Patients suffering from dysphagia, neurological disorders, or persistent vomiting may have difficulty retaining oral medications.[4,17] Mucoadhesive buccal tablets provide an effective alternative route of administration, ensuring reliable drug delivery and improved therapeutic outcomes.[7,18]

Future Prospects of Buccal Drug Delivery:

Development of Improved Permeation Enhancers

Future research is focused on developing safe and effective permeation enhancers that can increase drug absorption through the buccal mucosa without causing irritation or tissue damage.[13,44] Such advancements may further improve the bioavailability of buccal formulations.[16,50]

Enhancement of Patient Compliance

Improving taste masking, tablet size, comfort, and overall acceptability of buccal dosage forms can significantly enhance patient compliance, particularly among children and elderly patients.[17,18,21]

Scale-Up and Regulatory Considerations

The successful commercialization of mucoadhesive buccal tablets requires optimization of manufacturing processes, quality control methods, stability studies, and regulatory compliance.[40,41] Continued advancements in formulation technology and regulatory guidelines are expected to support the wider adoption of buccal drug delivery systems.[50]

CONCLUSION

Mucoadhesive buccal drug delivery systems represent a promising alternative to conventional oral drug administration, particularly for drugs that undergo extensive first-pass metabolism or are intended for use in patients with swallowing difficulties and recurrent vomiting. Ondansetron, a widely used antiemetic agent, is an ideal candidate for buccal delivery because its therapeutic effectiveness can be enhanced through direct absorption across the buccal mucosa, thereby bypassing hepatic first-pass metabolism and improving systemic availability.

The success of a mucoadhesive buccal tablet depends on the appropriate selection of polymers, formulation components, and manufacturing techniques. Polymers such as HPMC, Carbopol, Sodium CMC, Sodium Alginate, and Chitosan play a crucial role in providing adequate mucoadhesion, prolonged residence time, and controlled drug release. Comprehensive evaluation of physicochemical properties, mucoadhesive characteristics, drug release behavior, and permeation performance is essential for the development of an effective formulation.

In addition, buccal tablets offer significant advantages for paediatric, geriatric, and dysphagic patients, as well as for individuals requiring rapid antiemetic therapy. Their ability to provide improved patient compliance, enhanced bioavailability, and rapid therapeutic action makes them an attractive dosage form for ondansetron delivery.

Overall, the development of mucoadhesive buccal tablets of ondansetron is a scientifically sound and clinically relevant approach. Continued research in formulation optimization, permeation enhancement, and large-scale manufacturing is expected to further strengthen the potential of buccal drug delivery systems and contribute to the development of more effective and patient-friendly antiemetic therapies.

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