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A Review-Advances In Stomach-Specific Bioadhesive Tablets

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A B S T R A C T :

Stomach-specific bioadhesive tablets have emerged as a promising approach for enhancing the gastric retention of drugs with narrow absorption windows, poor solubility in intestinal fluids, or localized stomach action. These formulations utilize bioadhesive polymers to prolong gastric residence time, thereby improving drug absorption and therapeutic efficacy. This review discusses the formulation strategies, selection of bioadhesive polymers, evaluation parameters, and factors influencing bioadhesion in the development of stomach-specific bioadhesive tablets. The optimization of formulation variables to achieve sustained drug release and enhanced mucoadhesion is also highlighted. Advancements in polymer technology and novel formulation approaches hold significant potential for improving the clinical applicability of bioadhesive tablets in gastric drug delivery.

Keywords: **B**ioadhesive tablets, Gastric retention, Bioadhesive polymers, Drug absorption, Therapeutic efficacy, Formulation strategies, Mucoadhesion

1. Introduction

1.1 Oral Controlled Drug Delivery System[1,2,3]

In contemporary pharmaceutical sciences, it is widely recognized that a drug's effectiveness is influenced not only by its therapeutic activity but also by the efficiency of its delivery to the target site. This understanding has led to the evolution of innovative drug delivery systems that enhance the performance and therapeutic value of drug molecules. Although oral drug delivery systems that offer sustained release can address some biopharmaceutical and therapeutic needs, they often overlook the fact that drug absorption varies across different regions of the gastrointestinal (GI) tract. Consequently, there is a pressing need to design delivery systems that can release drugs at a controlled rate, at a specific location, and at the most appropriate time.

Drug delivery systems that are capable of remaining in the stomach for an extended period are known as gastroretentive drug delivery systems (GRDDS). These systems are particularly beneficial for drugs with a narrow absorption window, as they enable prolonged and controlled release in the stomach, thereby maximizing drug absorption and enhancing bioavailability.

The process of gastric emptying is highly variable, making it challenging to predict and control. The ability to delay gastric emptying and maintain the dosage form in the stomach longer than conventional systems is a significant advantage. Designing effective controlled-release systems faces several challenges, especially the difficulty of localizing the dosage form within a specific GI tract region. Since drug absorption from the GI tract is influenced by multiple factors, it is well established that the duration of contact between the drug and the intestinal mucosa directly impacts absorption efficiency. Therefore, intestinal transit time becomes a crucial parameter, particularly for drugs that are not fully absorbed.

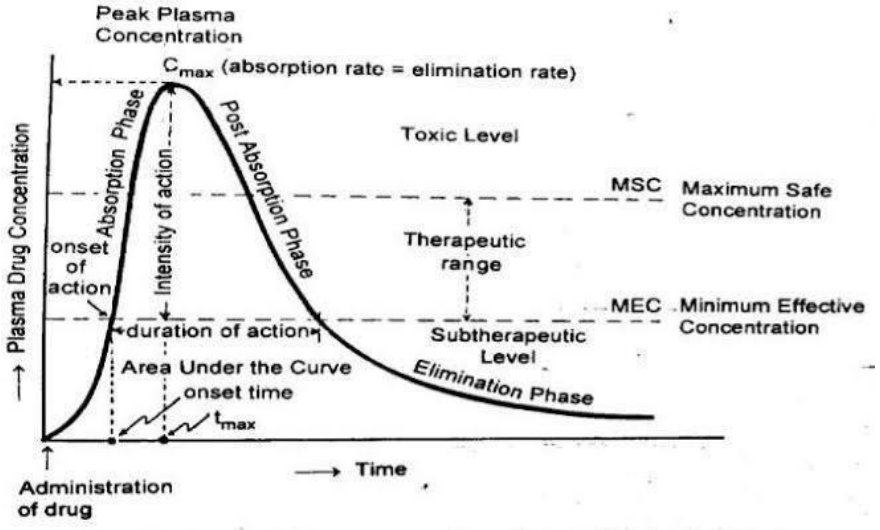

Figure No 1: Plasma Level Profiles Following Conventional And Controlled Release Dosing

Gastroretentive drug delivery systems are formulated to stay within the stomach for an extended duration, thereby increasing the time a drug remains in the gastric environment. This extended retention can enhance the bioavailability of certain drugs, reduce their loss through premature transit, and support better solubility for compounds that dissolve poorly in alkaline pH conditions. These systems are also useful for delivering drugs locally to the stomach or the upper portion of the small intestine. By keeping the drug in the stomach longer, these systems open the door to novel therapeutic approaches and offer meaningful improvements in patient care.

Various strategies are used to prolong the residence time of oral dosage forms in the stomach. These include mucoadhesive interactions, floating systems, density-based approaches like sedimentation, expandable formulations, altered geometric shapes, or co-administration with agents that slow gastric emptying. This review particularly emphasizes the role of mucoadhesion as a primary approach for achieving sustained gastric retention.

1.2 Stomach-Specific Bioadhesive Drug Delivery System[4,5]

In recent years, there has been growing interest in developing oral drug delivery systems capable of maintaining a drug within specific regions of the gastrointestinal tract (GIT) for a prolonged period. Among these, stomach-specific systems are particularly designed to retain the dosage form in the gastric region, allowing extended drug presence at the site of action.

The rationale behind gastroretentive formulations lies in enhancing therapeutic outcomes by ensuring that drugs remain in the stomach long enough to be effectively absorbed. This is especially important for drugs with limited absorption windows in the upper GIT. However, the journey of a drug through the digestive system—from intake to elimination—is influenced by a range of factors, including the physical nature of the formulation and individual variations in gastrointestinal physiology. As a result, controlling gastric residence time becomes essential for improving the efficiency of site-specific drug delivery.

In the human digestive system, drugs often face the challenge of being cleared from the stomach within a short span—usually around 2 to 3 hours—before they can be fully released and absorbed. This limited residence time, particularly in the upper gastrointestinal tract where absorption is most efficient, can result in reduced drug effectiveness. Maintaining prolonged contact between the formulation and the absorption surface can significantly improve drug uptake and its rate of absorption.

To address this, researchers have focused on creating oral dosage forms that not only provide extended drug release but also stay longer in the stomach. Designing such systems is especially important for medications that are absorbed only within specific, limited areas of the GI tract, like the stomach and the upper part of the small intestine. For these drugs, ensuring that the dosage form remains in the targeted region is crucial for maximizing therapeutic benefits.

1.2.1 Anatomy And Physiology Of Stomach[6,7,8,9]

All tables should be numbered with Arabic numerals. Every table should have a caption. Headings should be placed above tables, left justified. Only horizontal lines should be used within a table, to distinguish the column headings from the body of the table, and immediately above and below the table. Tables must be embedded into the text and not supplied separately. Below is an example which the authors may find useful.

a) Cardia

b) Fundus

c) Body

d) Pylorus

The **cardia** is the area at the top of the stomach where it meets the esophagus. Just above and slightly to the left of it lies the **fundus**, which is the curved upper portion of the stomach. The stomach itself has different parts: the **body** (the central region) and the **pylorus**, which connects to the small intestine (duodenum). The **pylorus** has two main sections — the **pyloric antrum**, located next to the stomach body, and the **pyloric canal**, which opens into the intestine. The **fundus and body** store food temporarily, release digestive enzymes and acids, and help mix the food with these secretions to form **chyme**. This semiliquid mixture is gradually pushed toward the antrum. The **antrum** helps break down food further, regulates acid levels, and pushes the contents toward the duodenum for digestion. The **pyloric sphincter**, about **12.87 mm** in diameter, acts like a gatekeeper — letting only small, properly digested particles pass through. While the stomach usually has a **J-shape**, it can also lie sideways or slant depending on body position. The lining where the esophagus meets the stomach is clearly marked by a sharp, zigzag boundary known as the **"Z-line"** or **"ZZ-line"**.

At the pylorus, the stomach's mucous membrane connects with that of the duodenum. The average stomach capacity is about 1.12–1.7 liters, with a volume of around 50 ml when empty.

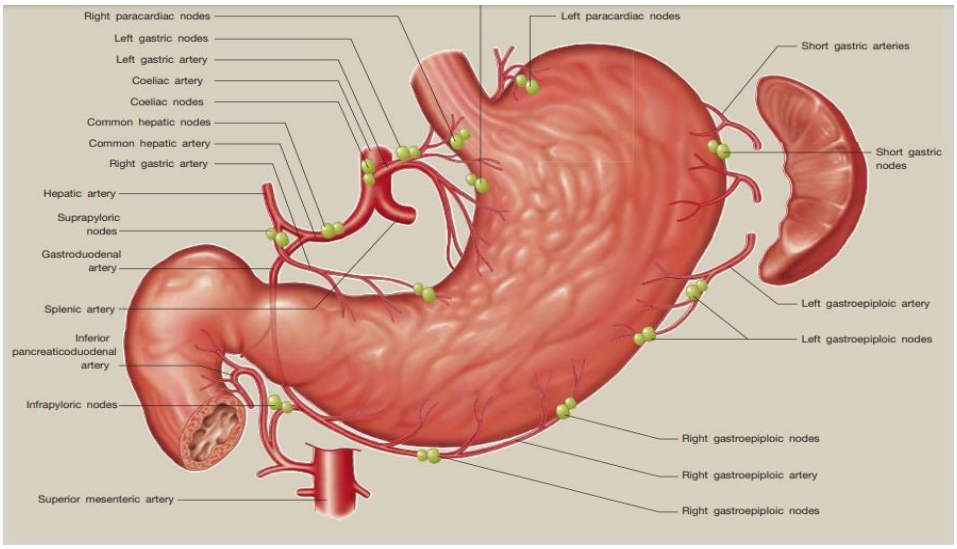

Figure 2: Anatomy And Physiology Of Stomach

The human stomach is divided into three main areas: the fundus, body, and pylorus, each featuring different types of glands. Just where the esophagus enters the stomach is a narrow area known as the cardiac region, about 1 to 4 cm wide, which is guarded by the cardiac sphincter to regulate food entry. The fundus lies between this region and the pylorus and represents the majority of the stomach's lining—covering around 60–80% of its inner surface. A small bend along the lesser curvature, called the *incisura angularis*, marks the shift from the lower fundus to the pyloric zone. However, there is no sharp boundary between these two sections; instead, there's a gradual transition. The pyloric part takes up roughly 15% of the stomach's inner area and includes two parts: the pyloric antrum (a wider area near the body) and the pyloric canal (a narrow, 3 cm tube leading to the pyloric sphincter).

The wall of the digestive tract consists of four distinct layers: mucosa, submucosa, muscularis externa, and either serosa or adventitia, depending on the location in the body. The innermost layer, the mucosa, surrounds the hollow space (lumen) where food travels and is responsible for crucial digestive tasks such as absorbing nutrients and releasing enzymes and mucus.

1.2.2 Approaches to achieve stomach-specific drug delivery system[10,11]

a) High density system or non-floating drug delivery system

This approach involves developing dosage forms with a density higher than that of typical gastric fluids, which is approximately 1.004 g/cm³. These formulations are designed to remain in the stomach by relying on gravity—they sink to the stomach's bottom and stay below the pyloric region. To achieve this, the drug is either layered onto a dense core or blended with heavy, non-reactive substances such as iron powder, barium sulfate, zinc oxide, or titanium dioxide. These additives can raise the formulation's density to between 1.5 and 2.4 g/cm³, with a target of around 2.5 g/cm³ considered ideal for prolonged gastric retention. Despite this promising concept, such systems have not demonstrated consistent success in human trials, and no products based on this method have reached the market.

b) Bio/Muco-adhesive systems:

Bioadhesive drug delivery systems (BDDS) are designed to retain a dosage form at a specific site within the gastrointestinal tract, thereby enhancing localized drug absorption. This technique utilizes bioadhesive polymers capable of attaching to the stomach's epithelial lining. For example, Sanap developed mucoadhesive gastroretentive beads containing Glipizide, using a variety of polymers such as sodium alginate, Carbopol 974P, and sodium carboxymethyl cellulose. However, one major limitation of gastric mucoadhesion is its inability to withstand the stomach's vigorous motility and peristaltic forces. The continuous renewal of gastric mucus, along with dilution from stomach contents, further weakens mucoadhesive strength, reducing the formulation's ability to remain in place. Despite these challenges, several excipients like polycarbophil, carbopol, chitosan, lectins, carboxymethyl cellulose (CMC), and gliadin have shown promising results in enhancing mucoadhesive properties. Researchers have also explored combining mucoadhesive strategies with floating systems to boost gastric retention. Innovative methods include the use of adhesive components derived from bacterial fimbriae (particularly Type 1) or their synthetic counterparts, enabling attachment to the gut lining and prolonged gastrointestinal residence. Additionally, formulations have been developed using viscous agents such as curdlan or low-substituted hydroxypropylcellulose, which help improve adhesion and retention in the stomach.

c) Floating Drug Delivery Systems

Floating drug delivery systems, a concept initially introduced by Davis in 1968, are designed to have a lower density than gastric fluids, enabling them to float on stomach contents rather than sink. This buoyancy allows the dosage form to remain in the stomach for longer durations, thereby increasing gastric residence time (GRT) and helping to stabilize fluctuations in blood drug levels. These systems, also termed hydrodynamically balanced systems (HBS), are generally in the form of tablets or capsules. They are formulated using gel-forming agents alongside the drug, which swell upon contact with gastric fluid and help maintain floatation. By staying afloat in the stomach, these systems ensure the drug is released in a controlled manner while being retained in the optimal site for absorption. This approach improves bioavailability by allowing the drug to dissolve in the stomach before progressing through the gastrointestinal tract.

i) Non-Effervescent Systems

Non-effervescent floating drug delivery systems rely on swellable polymers and gel-forming agents such as cellulose derivatives, natural polysaccharides, and matrix-forming compounds including polycarbonate, polyacrylate, polymethacrylate, and polystyrene. During formulation, the active pharmaceutical ingredient is uniformly blended with these hydrophilic polymers. Once ingested, the dosage form absorbs gastric fluid and expands, reaching a density approximately equal to that of the stomach contents. This swelling traps air within the polymer network, allowing the system to float. The expanded, gel-like matrix then functions as a controlled-release platform, gradually dispensing the drug over time as it diffuses through the hydrated polymer barrier.

ii) Colloidal Gel Barrier Systems

The Hydrodynamically Balanced System (HBS™), originally introduced by Sheth and Tossounian in 1975, is a gastroretentive drug delivery platform designed to float on gastric contents by maintaining low density. These formulations are typically single-unit systems, where the active drug is incorporated into a blend of swellable, gel-forming polymers—primarily cellulose-based hydrocolloids. Frequently used polymers include hydroxypropyl methylcellulose (HPMC), hydroxyethyl cellulose (HEC), hydroxypropyl cellulose (HPC), and sodium carboxymethyl cellulose, along with other matrix-building agents such as polycarbophil, polyacrylate, polystyrene, agar, carrageenan, and alginic acid. The drug-polymer mixture is often encapsulated within a specialized capsule that becomes buoyant after ingestion. When exposed to gastric fluids, the capsule shell dissolves, and the contents hydrate and swell to form a viscous, gel-like barrier that traps air, allowing the dosage form to float in the stomach for an extended duration.

To maintain floatation, the outer gel layer slowly erodes while still allowing water to diffuse inward, ensuring continuous swelling and sustained buoyancy. The inclusion of lipid-based excipients in the formulation can further slow down matrix erosion by lowering the overall density, enhancing gastric retention. A related innovation, the Microporous Compartment System, encapsulates the drug in a reservoir enclosed within a compartment that features micropores on its upper and lower surfaces. This design supports controlled drug release through diffusion pathways while preserving buoyancy in gastric conditions.

iii) Microporous compartment system:

In this advanced drug delivery strategy, the active pharmaceutical ingredient is enclosed within a compartment that features selective microporous openings located only at the top and bottom surfaces. The lateral walls are tightly sealed, preventing any immediate exposure of the undissolved drug to the gastric environment. Once administered, the presence of a built-in air chamber within the system enables it to remain buoyant on the gastric contents. As gastric fluids gradually enter through the micropores, the drug inside begins to dissolve. The dissolved medication then exits through the same openings, allowing a steady and controlled flow into the intestines, where it becomes available for absorption over time.

iv) Alginate beads:

Alginates have emerged as a promising material for designing multi-unit drug delivery systems due to their biocompatibility, non-toxicity, and biodegradability. Chemically, they are linear copolymers composed of alternating units of L-guluronic acid and D-mannuronic acid. A notable application involves creating floating microspheres using calcium alginate through a freeze-drying technique. These small spherical units, typically around 2.5 mm in

size, are produced by introducing a sodium alginate solution dropwise into an aqueous calcium chloride medium. This process instantly triggers ionic crosslinking, resulting in the formation of insoluble calcium alginate beads. To generate a porous structure capable of prolonged buoyancy, the beads are rapidly frozen in liquid nitrogen and then subjected to freeze-drying at approximately –40°C for 24 hours. The resultant system maintains its floatation for over 12 hours and has demonstrated gastric retention for periods exceeding 5.5 hours, enhancing its potential for controlled drug release applications.

d) **Hollow Microspheres:**

Hollow microspheres stand out as a highly promising approach among buoyant drug delivery systems due to their intrinsic central void, which enhances buoyancy and imparts the benefits of a multi-unit dosage form. These microballoons demonstrated the ability to float in vitro for up to 12 hours when placed in an aqueous environment. Radiographic evaluations revealed that, upon oral administration in human subjects, the microballoons remained dispersed in the upper stomach region and resisted peristaltic movement for approximately 3 hours. In a related study, Kamila and colleagues developed a multi-unit floating delivery system for rosiglitazone maleate. The formulation involved encapsulating the drug within Eudragit® RS100 using a non-aqueous emulsification followed by solvent evaporation technique. This system underwent comprehensive in vitro and in vivo assessments to evaluate its performance.

e) Effervescent (gas generating) systems:

Buoyancy in drug delivery systems can be effectively achieved by generating gas bubbles within the formulation. This approach typically involves the use of swellable polymer matrices—such as natural polysaccharides like chitosan—combined with effervescent agents like sodium bicarbonate and organic acids including citric or tartaric acid. Tadros MI designed a gastroretentive system that offers a combination of swelling, floating, and mucoadhesive characteristics. The optimal molar ratio for carbon dioxide generation using citric acid and sodium bicarbonate was found to be 0.76:1, which ensures effective buoyancy by releasing CO_2 gas, enabling the formulation to float in gastric fluids. Other notable techniques include using sodium alginate with sodium bicarbonate**,** and designing multi-unit floating systems that produce gas upon ingestion. Additionally, floating minicapsules have been formulated using a core of sodium bicarbonate, lactose, and polyvinyl pyrrolidone (PVP), coated with hydroxypropyl methylcellulose (HPMC). Floating systems utilizing ion-exchange resin technology have also been explored. Kumar and colleagues created floating matrix tablets of acyclovir using swelling agents such as HPMC K4M, HPMC K15M, and sodium alginate along with sodium bicarbonate as the gas-forming component. Mallikarjune et al developed effervescent floating tablets of glipizide using different grades of HPMC (K4 and K15) to assess their gel formation potential. Sodium bicarbonate served as the effervescent agent in their formulation. Furthermore, multilayered or bilayer systems have emerged as innovative strategies. Yadav et al introduced a dual-function floating-bioadhesive tablet using propranolol hydrochloride as the model drug. This design enhances gastric retention by combining adhesion to the stomach lining with buoyancy. The active agents and excipients can be structured in separate layers, with the effervescent component integrated into any layer. Some advanced formulations include coatings that are water-permeable but act as barriers to carbon dioxide escape. A key formulation challenge remains in achieving a proper balance between elasticity, flexibility, and the permeability of the chosen polymers.

f) Expandable, Unfoldable, and Swellable System

A drug delivery system can achieve prolonged retention in the stomach if its dimensions exceed those of the pyloric sphincter. However, it must also be compact enough for comfortable swallowing and to avoid the risk of gastric blockage, whether as a single unit or through accumulation. To meet these requirements, expandable dosage forms are developed. These systems are designed to be small in size during ingestion, enlarge once in the gastric environment to prevent premature passage, and eventually reduce in size again to facilitate safe elimination after the drug has been released. Enhancing gastric retention time (GRT) involves creating a system with significant expanded dimensions and sufficient mechanical strength to withstand gastric motility and peristaltic forces. The combination of bulk and rigidity helps maintain the formulation within the stomach despite its dynamic conditions.

g) Magnetic Systems:

These gastroretentive systems are typically designed as compact capsules embedded with magnetic materials. Their retention in the stomach is facilitated by the application of an external magnetic field positioned over the abdominal area, effectively preventing their passage through the pyloric region. Although various studies have demonstrated promising outcomes, the practical use of these systems remains questionable. The effectiveness largely depends on the highly precise placement of the external magnet, which poses a significant limitation. Future advancements in user-friendly magnetic field devices may enhance the feasibility and reliability of this approach.

1.2.3 Factors Affecting Gastroretension[12]

1) Density – The gastric retention time (GRT) of a dosage form is strongly influenced by its buoyancy, which is directly related to its density.

2) **Size** – It has been observed that dosage forms with diameters exceeding 9.5 mm exhibit prolonged gastric residence time.

3) **Dosage Form Shape** – Devices shaped like tetrahedrons or rings, possessing flexural moduli of approximately 48 and 22.5 KSI respectively, demonstrate superior gastric retention—showing up to 90–100% retention over a 24-hour period compared to other geometries.

4) **Formulation Type (Single vs. Multiple Units)** – Multi-unit dosage systems offer greater reliability in drug release, reduced risk of total dosage failure, the flexibility to include varied release kinetics or incompatible compounds in one administration, and improved safety margins compared to single-unit forms.

5) **Feeding Status (Fasted or Fed State)** – During fasting, gastrointestinal motility includes cyclical intense contractions known as the migrating myoelectric complex (MMC), which occur every 90 to 120 minutes and can rapidly expel undigested material, leading to shorter GRT. In contrast, food intake suppresses MMC activity, thereby enhancing gastric retention duration.

6) **Meal Composition** – Consuming indigestible materials such as polymeric substances or salts of fatty acids may convert the gastric environment to a fed state, reducing emptying speed and prolonging drug retention.

7) **Nutritional Content** – Meals rich in protein and fat can significantly delay gastric emptying, extending GRT by approximately 4 to 10 hours.

8) **Meal Frequency** – Repeated feeding events can prolong GRT substantially—by more than 400 minutes—compared to a single meal, due to reduced MMC activity.

9) **Sex-Based Differences** – Males typically show shorter mean GRT values (around 3.4 ± 0.6 hours) than females (around 4.6 ± 1.2 hours), even when body mass and surface area are accounted for.
10) **Age Factor** – Individuals aged over 70 years tend to experience notably prolonged gastric retention periods compared to younger populations.

1.3 *Bioadhesive Drug Delivery System*[13]

Bioadhesion refers to the adherence of natural or synthetic polymers to biological surfaces, such as epithelial tissues, for extended periods. When this adhesion specifically occurs on mucosal surfaces, the term "mucoadhesion" is used. In the context of drug delivery, mucoadhesion typically describes the bonding of a polymeric drug carrier to either a mucus layer or epithelial lining. Bioadhesion in drug delivery systems generally describes the capacity of a polymer-based carrier to remain attached to biological tissue for an extended duration, thereby increasing the local concentration of the drug at the absorption site and enhancing its overall bioavailability.

The inner linings of various body parts are coated with a thick, gel-like substance called mucin, which is secreted by goblet cells and certain exocrine glands that contain mucous-producing cells. These mucosal membranes cover internal cavities and channels such as those found in the digestive, respiratory, and urogenital tracts, as well as in regions like the mouth, nasal passages, eyelids, lungs, stomach, intestines, ureters, urethra, and bladder. These mucus-covered areas serve as ideal locations for the application and retention of bioadhesive drug delivery systems.

1.3.1 *Mechanism Of Bioadhesion*[14,15,16]

Bioadhesion refers to the process by which natural or synthetic polymers adhere to biological surfaces such as epithelial tissues for extended periods. When this adhesion occurs specifically on mucosal surfaces, the term mucoadhesion is commonly used. In the context of drug delivery, mucoadhesion describes the interaction between a polymer-based material and a mucous membrane, while bioadhesion can broadly indicate attachment to any biological surface, including epithelial tissue.

For drug delivery applications, bioadhesion is characterized by the capacity of a drug delivery system—typically composed of polymers to remain attached to biological tissues for an extended duration. This prolonged contact time can enhance drug absorption by maintaining a high concentration gradient at the site of uptake, leading to improved bioavailability.[14]

For adhesion to take place, bonding must occur between molecules at the interface. These interactions can develop through several mechanisms:

1)Ionic interactions – These occur when oppositely charged ions are attracted to each other due to electrostatic forces, forming a stable and strong bond, as typically seen in salt crystals.

2)Covalent bonding – In this type of interaction, atoms share pairs of electrons to complete their outer electron shells. Covalent bonds are among the strongest chemical bonds.

3)Hydrogen bonding – When hydrogen is covalently bonded to electronegative elements like oxygen, nitrogen, or fluorine, it carries a partial positive

charge. This allows it to be attracted to nearby electronegative atoms, creating a relatively weaker bond compared to ionic or covalent bonds.

4)Van der Waals forces – These are weak, non-covalent interactions arising from dipole–dipole attractions, dipole-induced dipole interactions in polar molecules, and dispersion forces in non-polar molecules.

5)Hydrophobic interactions – More accurately described as the hydrophobic effect, this is not a true chemical bond but a phenomenon where non-polar groups in aqueous environments tend to cluster together. This occurs because surrounding water molecules form ordered hydrogen-bonded structures, decreasing entropy. As a result, non-polar groups aggregate to minimize this entropy loss.

1.3.2 *Theories Of Bioadhesion*[17]

1) Wetting theory
2) Diffusion theory
3) Electronic theory
4) Adsorption theory
5) Fracture theory

1.3.3 *Advantages Of Bioadhesive Drug Delivery System*[18]

1) The formulation remains at the absorption site for an extended period, promoting sustained interaction with the biological membrane.
2) It effectively circumvents hepatic first-pass metabolism, allowing more drug to enter systemic circulation.
3) A longer retention time at the site of absorption boosts drug uptake, thereby amplifying its therapeutic action.
4) The delivery site is readily accessible, making administration more efficient and convenient.
5) Swift absorption is achieved owing to the dense network of blood vessels and robust perfusion at the site.
6) By avoiding liver metabolism on the first pass, the formulation leads to a marked improvement in systemic drug levels.
7) The approach safeguards the active ingredient from breakdown in the acidic environment of the stomach.
8) The ease of administration and reduced dosing complexity contribute to enhanced patient compliance.

1.3.4 Disadvantages Of Bioadhesive Drug Delivery System[18]

1) Certain drugs when ingested undergo drug destruction; there are several drugs which are potentially in this category. Many drugs affect liver metabolism and cause destruction via first pass metabolism of other drugs.

2) Medication administered orally does not enter the blood stream immediately after passage through the buccal mucosa. Instead, they have to be swallowed and then have to pass through a portion of the GIT before being absorbed. So, the action is not very rapid in the GIT as compared when the drug is administered through the buccal route.

3) Oral ingestions result in more exposure of a drug to GI tract.

4) The absorption of mucoadhesive drugs is adversely affected by the presence of food. Tetracyclines complicate the administration of this class of antibiotics via the oral route.

1.3.5 Examples Of Bioadhesive Polymers[19]

Macromolecules known as polymers consist of numerous repeating units called monomers, which are chemically joined through a process termed polymerization. These substances are generally grouped into two main types: those derived from natural sources and those produced synthetically.

1)Natural Polymers

Polymers	Source	Type
Chitosan	Animal (e.g., crustaceanshells)	Polysaccharide
Alginates	Algae	Polysaccharide
Xanthan Gum	Bacterial Fermentation	Polysaccharide
Tragacanth	Plant (Astragalus tree)	Polysaccharide
Acacia	Plant (Acacia tree)	Polysaccharide

2)Synthetic Polymers

Polymers	Type	Common Applications
Eudragit ®	Vinyl polymer	Coating, Drug release modifiers
Polyvinyl pyrolidone (PVP)	Vinyl polymer	Binder, Solubilizer
Carbomers	Acrylic acid polymer	Gel formation, thickener
Cellulose Ethers	Cellulose derivative	Binder, film former
Methyl cellulose	Cellulose derivative	Binder, viscosity enhancer
Ethyl cellulose	Cellulose derivative	Film former, enteric coating
Hydroxypropyl cellulose (HPC)	Cellulose derivative	Binder, film former
Hydroxyethyl cellulose (HEC)	Cellulose derivative	Viscosity enhancer, thickener
Hydroxypropyl methyl Cellulose (HPMC)	Cellulose derivative	Binder, disintegrant, film former
Sodium carboxy methyl cellulose (SCMC)	Cellulose derivative	Binder, disintegrant
Polyether	Synthetic polymer	Binder, thickener, viscosity enhancer
Silicones	Synthetic polymer	Encapsulation, barrier formation

CONCLUSION

Stomach-targeted bioadhesive tablets offer a promising innovation in drug delivery by increasing gastric retention, improving absorption rates, and extending the duration of therapeutic action. The effectiveness of these systems heavily depends on the careful selection of mucoadhesive polymers and well-designed formulation techniques to achieve optimal adhesion and controlled release. Multiple assessment methods are used to evaluate the functional performance of such dosage forms. However, certain limitations persist, including inconsistent gastric retention times and biological variables that influence mucoadhesion. Advancements in this field should prioritize the development of novel adhesive materials, creative formulation methods, and comprehensive in vivo studies to support their practical application in gastric-specific drug delivery.

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