GASTRORETENTIVE APPROACHES FOR CONTROLL RELASED: A REVIEW

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Abstract

Due to a short residence period in the upper minor intestine, oral solid drug absorption with a limited absorption window exhibits poor bioavailability with conventional dosage forms. To get over this limitation and enhance bioavailability of the drugs, CDDS (controlled drug delivery systems) with a protracted stomach holding time is employed. One can make use of gastric retention medication delivery method to extend the duration of time a drug stays in the upper gastrointestinal tract. Many efforts have been made in recent years to increase the therapeutic effectiveness and medication bioavailability orally administered dosage forms. In this situation, a variety of GRDDS (drug delivery systems of gastro retentive) have been employed to increase the therapeutic effectiveness of medications with a limited window of absorption, alkaline pH instability, solubility in acidic conditions, and local stomach activity. Several elements, including pharmaceutical considerations, physiological factors, and other factors related to patient are described together with the stomach's physiological state. After that, we studied a number of gastro retentive techniques that have been created and refined to far, including the floating system, effervescent floating DDS such as raft forming system and gas generating system, high density systems (sinking), bio adhesive system, expanded system, ultra-porous hydrogel system and magnetic system. At the end a brief explanation of future prospective of GRDDS has being underlined.

Keywords: Oral controlled release, Gastric retention, Approaches, Muco-adhesion, High Density system

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1. Introduction

The easiest and most popular way to administer medications is via the oral route[1]. At least 90% of all medications administered orally are likely to do so[2]. The oral administration is the commonly prescribed route to deliver drugs. In addition to having patient compliance, ease of ingestion, pain avoidance, cost effectiveness, ease of storage, and versatility to accommodate a variety of medications, it is also easy to store and transport[2]. The oral drug delivery system has, however, been plagued by many problems such as unpredictable gastric emptying rates, surface areas, and enzymatic activity [1,4]. It may not be possible for conventional medication delivery systems to address the challenges posed by the digestive tract[3]. When given orally, medications supplied in an usual dosage form have poor bioavailability i.e. they absorb at a slower rate and to a lesser extent than expected. With some medications, just 30% or less of the oral dose may be absorbed. To counteract this effect, very large dosages of the medicine are frequently supplied in order for the medically necessary amount to be absorbed. This method might be pricey when used with expensive medications, and the substance that is absorbed might also have unfavourable side effects in the digestive system. Moreover, poorly absorbed medications frequently exhibit significant intra- and inter-day variations in bioavailability[5]. Due to these issues, researchers have found a novel method of delivering medicine that can be maintained for a set amount of time in the stomach[1]. After numerous attempts, researchers have created a drug delivery method that maintains a therapeutically beneficial plasma drug concentration for long enough to reduce medication volatility and dosage frequency[4]. For both local and systemic effects, it is important to target site specific medication release in upper GIT, drug delivery of gastro retention is a strategy to extend stomach residence time [6,7]. Those that are less dissolvable in alkaline pH, are degraded by it, or are encountered in the bottom section of the GIT. GRDDS are advantageous for like drugs.

The mechanism of solid dose forms regulated gastric retention may include:

1. Muco-adhesion
2. Expansion
3. altered form systems
4. Flotation
5. Sedimentation
6. Expansion[1].

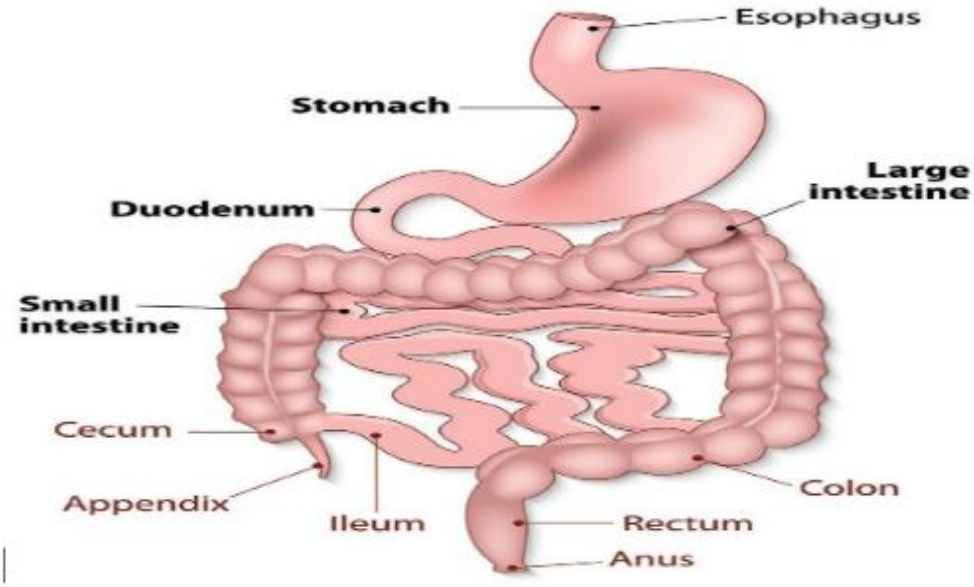
Table 1. Traditional versus gastro-retentive drug delivery methods

S. No.	Characters	Traditional DDS	GRDDS
1	Poorly soluble drugs at alkaline PH	Not very beneficial	Extremely convenient
2	Dose dumping	Risk of dumping doses is high	No risk of dose dumping
3	Drug having a short intestinal absorption window	Not acceptable	Suitable
4	Patient compliance	Less	Boost patient adherence
5	Drug that breaks down in the colon	Not very beneficial	extremely advantageous
6	Toxicity	High potential for toxicity	No toxicity threat

Anatomy of The Gastrointestinal Tract
The Anatomical structure and pathophysiology of the GIT
GIT is divided into 3 major regions, which are: -

1. **Small Intestine**
2. **Large Intestine**
3. **Stomach**

Distal stomach: Antrum
Proximal stomach: Fundus, Body
The digestive tract is essentially a nine-meter-long tube. It encompasses the throat and extends from the mouth to the anus in the centre of the body contains the throat(pharynx), Esophagus, stomach (Fundus, body and antrum), large intestine (containing the rectum, colon, appendix, and cecum.) and small intestine (comprising the ileum, jejunum, and duodenum)[5]. The fundamental tissue composition of the GIT walls Are identical from the stomach to the large intestine. and the many layers, including serosa, inter muscular plane, submucosa, muscular mucosae, circular muscle, lamina preppie, longitudinal muscle and epithelium, in order from outside to inside. The stomach is divided into three muscle layers: lateral, globular, and "ambiguous muscularis located in the proximate stomach, this nerve branches and over fundus and higher parts of the stomach organs."



Figures 1. Human digestive system.

Gastrointestinal utility and emptying of food:
Gastrointestinal transit and emptying are two of GIT's motor tasks that are carried out by the various smooth muscle layers[1]. The stomach comprised three compartments: fundus, body, and antrum. While driving causes stomach emptying, the fundus and body of the proximal region act as a tank for undigested things. Gastric emptying happens during fasting and during feeding[6].
Electrical events' inter-digestive series that cycles through the stomach and intestine every two to three hours occurs during the fasting state. It is also referred to as the migrating myoelectric cycle (MMC) and is then broken down into 4 steps. After

consuming a mixed meal, the peristaltic pattern transitions from the fasting to the feeding state. This is also called the gastrointestinal tract motility pattern[7].

Phases

- Phase 1 (Basal phase): non-contractional phase
- Phase 2 (Pre-burst phase): Intermittent contraction stage
- Phase 3 (Burst phase): At the peak distally migrating rate, there is frequent contraction time.
- Phase 4 Phase 3 to phase 1 transition period[17].

Phase 1	It is a quiet time frame without contractions that will last 30 to 60 minutes.
Phase 2	This comprises of sporadic contractions that last 20 to 40 minutes and get stronger as the procedure goes on. Gastric fluid and extremely small particle discharge starts earlier in the process.
Phase 3	Brief interval of intense distal and proximal gastrointestinal contraction (4-5 contractions per minute) that lasts 10 to 20 minutes and sweeps the gastric contents of the small intestine.
Phase 4	Contractions stop during this brief transitional time between the conclusion of phase 3 and the start of phase 1 quiescence, which lasts for little under 0 to 5 minutes.

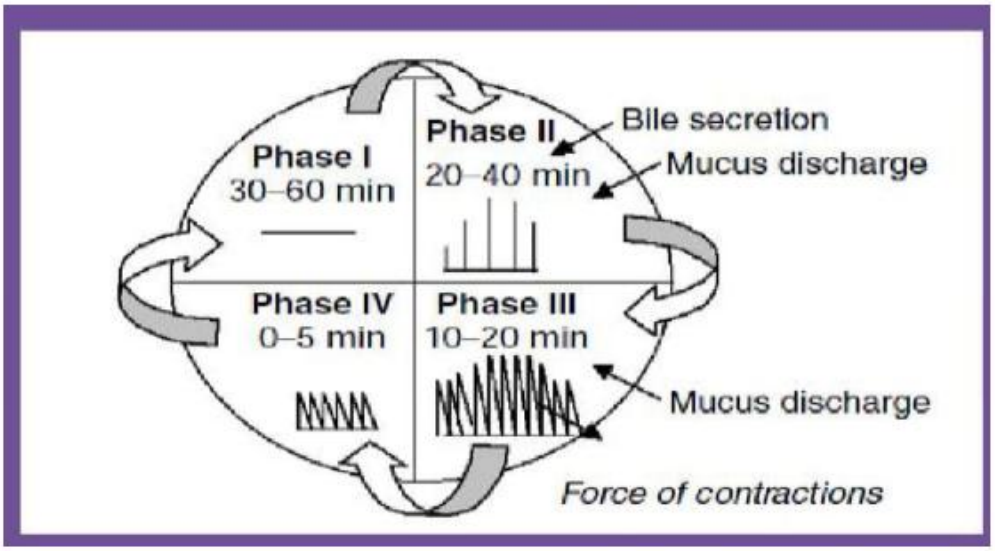


Figure2. Migrating motor complex

Gastric content composition:
The tummy can hold between 1.12 and 1.5 L. Young individuals' napping stomachs range in pH such as 1.7 to 1.3 inside the older one. Every 24 hours, the average stomach secretes about 3L of liquid, mostly made up of mucus, lipase enzyme, pepsinogen, and acid.

Inherent components, primarily related to gastric secretion,

1. While fasting, the stomach's pH is maintained between 1 and 3.5 by the acids produced by the parietal cell.
2. Mucus started from the surface gastric mucosa and lines the mucosa
3. The pepsinogen precursor of the pepsins produced by the development of peptic cells
4. Gastrin hormone, which is a powerful modulator of gastric acid[18].

Factors Affecting Gastric Retention

Several factors influence the gastro retentive pharmaceutical formulations' overall performance. These elements are primarily classified into:

1. Drug-related factors
2. Patient-related factors
3. Physiological factors[13].

1. Pharmaceutical factors:

For the effective achievement of GRDDS Understanding how excipients and polymers affect different forms of GRDDS is essential. For example, high muco-adhesion strength polymers such as carbopol and HPMC are needed within the system of mucosal adhesives to ensure the success of the mucoadhesive dosage form design. In the same way, polymers which have high swelling capabilities are selected for the expandable System. Additionally, the form of dosage might be affected by the viscosity, molecular weight, physiochemical characteristics of polymers. Other formulation elements may be required, such as sodium croscarmellose excipients with high swelling and crospovidone for superporous hydrogels[3].

i. **Density**- Dose form density should be less than that of the gastric contents (1.004g/ml).
ii. **Size-** The stomach residence time of dosage forms larger than 7.5mm is longer than that of dosage forms with a 9.9 mm diameter.
iii. **Form of the dosage unit -**Compared to other things of a same size, the tetrahedron lasted in the stomach longer.
iv. **Formulations of single or multiple unit:** When compared to single unit dosage forms and the co-administration of units with different release profiles or containing incompatible chemicals, multiple unit formulations offer a more predictable release profile and no performance degradation because of unit failure, giving them a higher margin of safety against dosage form failure[7].

2. Physiological Factors:

i. **Fed or unfed state:** While fasting, the GI motility is characterised by bursts of intense motar activity that occur every 1.5 to 2 hours. Undigested material is removed from the stomach by the MMC, and if the formulation's timing and the
ii. MMC are same, hence the unit's GRT can be brief. In contrast, the GRT is longer when the MMC is delayed in the fast state.
iii. **Type of food -** The stomach's motility pattern may change to a fed condition if it is fed with indigestible polymers or fatty acids, which will decrease gastric emptying and prolong drug release.
iv. **Calorific value** - A meal high in protein and fat may cause a 4- to 10-percent increase in gastric resident time (GRT):
v. **Regularity of feeding** - When compared to a single meal, the GRT

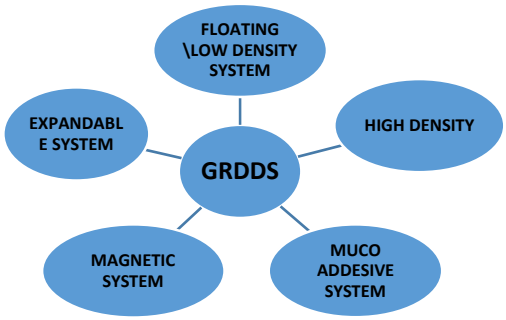
can increase by more than 400 minutes as a result of the low frequency of MMC[7].

3. Patient-Related Factors:

GRDDS may be affected by patient-related variables as age, gender, sickness, and emotional state, etc.

i. **Gender** - Males have a shorter mean ambulatory GRT than females of the same age and race (3.4 hours), regardless of height, weight, or body surface (4.6 hours).
ii. **Age**: Individuals older than 70 have much longer GRT
iii. **The emotional state**: The patient's mental state appears to have a role in determining the gastric residence duration because it has been discovered that the stomach emptying rate decreases in the depressed emotional state of the patient, and the opposite is seen in persons who are anxious[18].
iv. **Presence of illness**: Being unwell is another consideration, as pathological disorders like Parkinson's disease and diabetes mellitus might affect the stomach residence time[18]. There is a 30–50% reduction in stomach emptying in type I and type II diabetes that has been present for a long time.

Approaches To Gastro Retentive Drug Delivery Systems:



(1) Floating System:

J. DAVIS originally presented this technique in 1968**.** The phrase "hydrodynamically balanced systems" is sometimes used. Bulk density must be less than (1.004 g/cm) for floating [11,12]. Because of this, they enable a dose form to float for longer in the stomach.

(A) Non-effervescent:

Sheth PR and Tossounlan J described it for the first time in 1984[8]. Non effervescent systems sail due to two possible mechanisms[15]. The first is dependent on the addition of a polymer with a high swelling and gelling capacity, such as polysaccharides and polymers that form matrices (e.g polycarbophil, polystyrene and polyacrylates) cellulosic hydrocolloids (such as hydroxypropyl cellulose, hydroxypropyl methylcellulose, and hydroxyethyl cellulose) [12,15]. When these gel formers, polymers, and polysaccharides came in contact with stomach fluid, they hydrate and form a colloidal gel barrier, which regulates the rate of fluid invasion and subsequent medication release. The adjacent hydrocolloid layer's hydration preserves the gel layer when the dosage form's external surface dissolves[12]. The second mechanism may be associated to floating, as these systems rely on inserting a gas-filled compartment with a high specific gravity inside a microporous part to allow the system to float[15].

Hydro dynamically balanced system: The integration of a significant amount (20–75% w/w) of the combination of a gel-forming hydrocolloid and medicine is required for the formulation of hydrodynamically balanced systems

because this permits the drug to float above the stomach contents One or more hydrocolloids of the cellulose type that form gels, such as ethyl cellulose, alginic acid and hydroxypropyl methyl cellulose may be present in these systems. Additionally, matrix-forming polymers like Polycarbophil and Polyacrylate are present. Such systems hydrate hydrocolloid upon contact with stomach juices, forming a colloid gel barrier on their surface. Using a variety of polymers, including HPMC K4M and ethyl cellulose, a system with hydrodynamic balance of metformin was prepared as a solitary floating capsule. Gamma scintigraphic studies showed that the prepared formulations remained buoyant for 6 hours. It was also discovered that drug discharge from the customised HBS formulations could be prolonged for an extended period of time, with Cmax and Tmax reaching 76.97 percent in 7 hours, compared to 76.97 percent in 24 hours[15].

Micro-balloons: These are also referred to as hollow microspheres that have polymer outer shells and are heavily laden with drugs[14]. Solvent evaporation or solvent diffusion procedures are utilised in the preparation of these systems to form hollow inner cores. In the creation of such systems, polymers like Eudragit S, chitosan, polycarbonate and polyvinyl acetate are frequently employed[15]. Optimizing the polymer's quantity and plasticizer to polymer ratio will reduce the amount of medication released. To increase riboflavin's absorption and prolong the GRT, Vitamin microspheres that are hollow have been created. Theophylline hollow microspheres were made using a solvent evaporation method and polymers cellulose acetate Eudragit and butyrate RL 100[15]. These manufactured hollow microspheres floated continuously over the top of an acidic dissolving medium with surfactant for more than 12 hours[14]. The ethanol: After pouring a dichloromethane solution of the drug and an enteric acrylic polymer into an agitated aqueous solution of polyvinyl alcohol that was thermally controlled at 40 C, the gas phase is formed in the dispersed polymer by the evaporation of dichloromethane formed and an internal cavity in the polymer's microsphere with drug[14].

Alginate beads: Due to the high entrapment rate of alginate-containing formulations, A unique floating drug delivery system was created through using the ionic gel formation to create multi-unit floating spherical beads. The alginate solution was mixed with an aqueous system of calcium chloride, resulting in the precipitation of calcium alginate, which was then freeze dried to produce floating alginate beads of roughly 2.5 mm in diameter. Following the separation of the beads, snap-freezing in liquid nitrogen, and freeze-drying at 400 C for 24 hours. A porous system that remained buoyant in the stomach and provided a more than 5.5-hour residential period was developed[14].

Micro-porous chamber: A drug storage facility is enclosed in this GRDDS's microporous chamber with pore spaces on the top and bottom walls. As a result of the trapped air in the flotation compartment, the delivery system would become buoyant and floats just above stomach contents[14]. When gastric liquid passes through the pores and dissolves the medicine, it can be released through the gaps inside the stomach and anterior portion of the small intestine for absorption [14,15].

(B) Effervescent floating drug delivery systems:

These buoyant systems of distribution make use of matrices made with effervescent components, as in citric acid, sodium bicarbonate or tartaric acid, and polymers that swell, for example Polysaccharides, Methocel and chitosan. Matrix with liquid-filled chambers that gasify between 24-26 body temperatures. A chamber that floats made up of combination of vacuum, air or an inert gas

used to make a medication delivery system float in the stomach. The volatilization of an organic solvent, such as ether or cyclopentane, or the CO2 produced by the effervescent reaction between organic acids and carbonate-bicarbonate salts, can both introduce gas into the floating chamber. The volatilization of an organic solvent, such as ether or cyclopentane, or the CO2 produced by the effervescent reaction between organic acids and carbonate-bicarbonate salts, can both introduce gas into the floating chamber. The matrices are made so that when they enter the stomach, the acidity of the gastric Contents releases carbon dioxide, which is then trapped in the gellified hydrocolloid. This causes the dose form to move upward and keeps it buoyant. The dose Form floats atop the chyme when the specific gravity decreases[9].

Gas Generating system:

The creation of carbon dioxide as an outcome of the effervescent interaction between citric/tartaric acid and carbonate/bicarbonate salts determines how these systems float [13,15]. For gas generation, a stoichiometric ratio of 0.76:1 between citric acid and sodium bicarbonate is recommended. An approach is to include a matrix with liquids trapped inside that, when heated to body temperature, transform into a gas. Both single-unit systems and systems with many units have adopted these strategies[12]. Due to the inclusion of polymers like methyl cellulose and chitosan, and carbomer the gas was kept in the gel's hydrocolloid matrix[15]. When the preparation is placed in the beaker, it will sink since CO2 is released when there is water present. However, when gas is produced, it rises up and floats[3]. Additionally, multilayer or bilayer systems have been created. Drugs and excipients can be synthesised individually, and the gas-producing ingredient can be added to any of the layers[16].

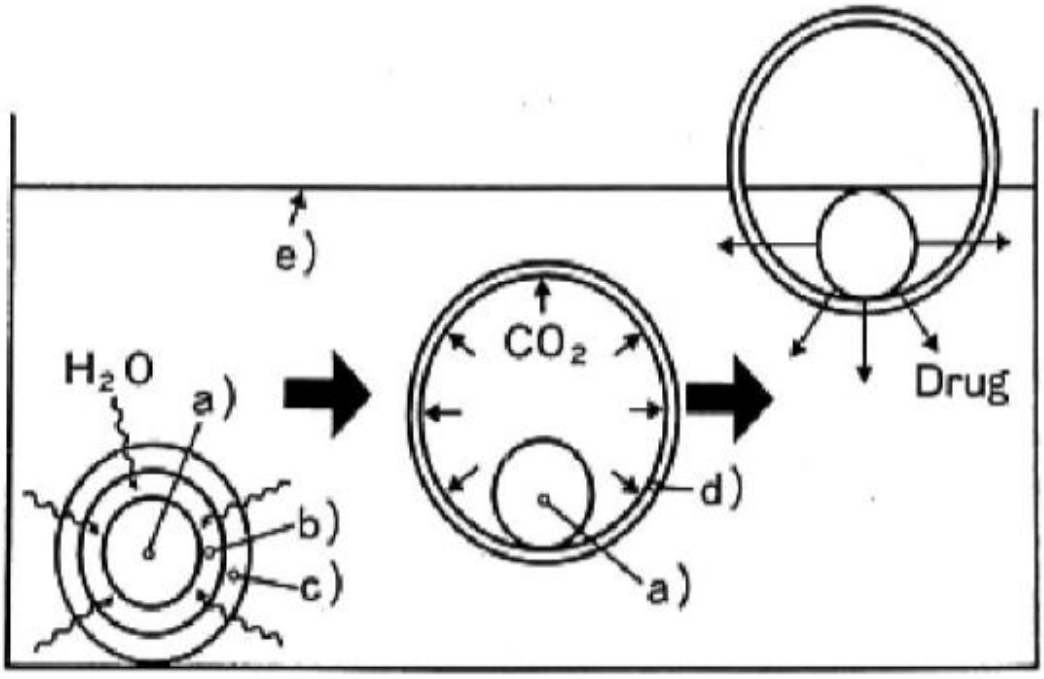


Figure 3. Gas Generating System

Volatile liquid containing system:

Two chambers in this kind of device are connected by a pressure-responsive impermeable, moveable bladder. The medicament is in the first compartment, while the volatile liquid is in the second. By

incorporating an inflatable container that contains a liquid that gasifies at normal body temperature to cause the compartment to expand inside the stomach, such as ether or cyclo-pentane, A drug delivery system's GRT can be kept constant[25]. A bio-erodible plug made of polyvinyl alcohol, polyethylene, etc. could also be part of the equipment that steadily dissolves and causes the enlarged compartment to expel gas and collapse following a predefined period, allowing the systems that inflate to emerge from the stomach on their own . As soon as the device is inflated, the medication is continually injected into the stomach fluid from the reservoir[12].

Raft forming system:

In order to assure sustained drug delivery, raft-forming systems, another type of GRDDS, are created using excipients that bubble up when they are mixed with gel-forming polymers**[3].** Liquid Gaviscon, a widely marketed product for the diagnosis of hyperacidity based on the usage of potassium bicarbonate and sodium alginate, is one of the best-known instances of raft-forming systems. When the stomach fluids are in touch with the continuous cohesive gel layer, which contains an entangled carbon dioxide bubble, the raft-forming machinery works. This stratum is known as a raft[15]. The raft floats on top of the stomach's contents due to the creation of CO_2 that was trapped in the raft, which caused it to have a low density compared to the stomach fluids. Blockades between the oesophagus and stomach are floating rafts. They can therefore be utilised to effectively manage gastric esophageal reflux illness[3]. Various natural and synthetic polymers are used to create the raft-forming medicine delivery mechanism. Natural polymers including chitosan, guar gum, gellan gum and alginic acid are combined with synthetic polymers like poly (DLlactide-co-glycolide), poly-caprolactone, poly (DL-lactic acid), and HPMC to create raft-forming drug delivery systems[26]. These processes have gained a bunch of interest in the delivery of antacids and medications used to treat the condition of gastroesophageal reflux Because of its ability to float over the GIT fluid, liquid Gaviscon is an example of a pharmaceutical preparation built on the raft formation theory and used to treat GERD[15].

(2) System of high density:

A high-density system is one in which the drug's density exceeds that of the stomach fluid. These are the systems that can remain in the stomach's bottom and hence do not cross the pyloric region since they have a density of 1.5 to 2.5 gm/cm3[13]. Hoelzel made the initial discovery of the impact of high density on GRT in 1930[27]. In general, the stomach retention duration of High-density drugs was longer than that of light density systems. The High-density System enhances Gastric Retention Time. However drugs with high density and high dose are very important[10].

(3). Bio adhesive/muco-adhesive systems:

Park & Robinson created the mucoadhesive/bio-adhesive system for the first time in 1984[10]. Drug absorption is enhanced at the point of contact using bio-adhesive drug carriers because they are made to be localised and bonded to the stomach lumen mucous membrane[15]. Here, the drug acts through adsorption or binding to the surface of the gastric epithelial cell in order to increase the drug's gastric residence time (GRT) in the stomach. The medicine is integrated into the mucoadhesive agent, a polymer that can be either synthetic or natural, in this method. Typically, the medicine is released when the mucosal surface and the polymer engage, causing the drug to release as a result[28].

This system operates in two phases: interaction and consolidation. The mucoadhesive system frequently uses polymers like chitosan, carbopol, polyethylene glycol, HPMC, polycyclic acid, etc. After being administered, the

medicine forms a bond with the mucosal layer as it reaches the application site, extending the stomach residence period[10]. Such polymers may adhere to biological membranes through hydration, H-bonding, or receptor-mediated adhesion[15]. The mucoadhesive agent binds to the mucin by hydrogen, electrostatic, hydrophobic, and disulphide bonds and is non-irritating, non-toxic, and site-specific[10]. One example of a drug that has been made into a bio-adhesive drug delivery system Carbopol 934P and sodium carboxy methylcellulose, both of which polymers have a substantial impact on the bio-adhesive strength of the tablets, are used in the formulation of oral drug delivery mucoadhesive compressed hydrophilic matrices of atenolol[15]. Simvastatin was formulated as prolonged release mucoadhesive matrix tablets with a GI tract absorption window by using a polysaccharide derivative from tamarind seeds (Thiomer) to improve muco-adhesion. This allowed for a positive effect as a dietary supplement in the treatment of hypercholesterolemia and dyslipidaemia. Thiomer placebo remained in the rabbit's body for longer than 7 hours[15].

The fundamental principle of adhesion is that numerous mechanisms might cause a dose form to adhere to the mucosal surface. These systems include[16]:

- **Wetting Theory**: The foundation of the wetting theory is the bio-adhesive polymers capacity to disperse and come into contact with mucosal layers directly.
- **The diffusion theory** suggests that mucin strands physically entangle with flexible polymer chains or interpenetrate the polymer substrate's porous nature.
- **According to the absorption theory**, secondary forces like Vander Waal forces and hydrogen bond layers are what cause biological adhesion[16].
- **The electrostatic:** The electron theory proposes an attraction between the glycoprotein mucin network and the bio adhesive substance. Chitosan, sodium alginate, Polyacrylic acid, hydroxypropyl methylcellulose (HPMC), cholestyramine, sucralfate, tragacanth, dextrin, polyethylene glycol, and polylactic acids are examples of materials frequently utilised for bio-adhesion[29]. Despite the fact that many of these polymers produce excellent bio-adhesives, maintaining it successfully is highly challenging due to the digestive tract fast mucus turnover[16].

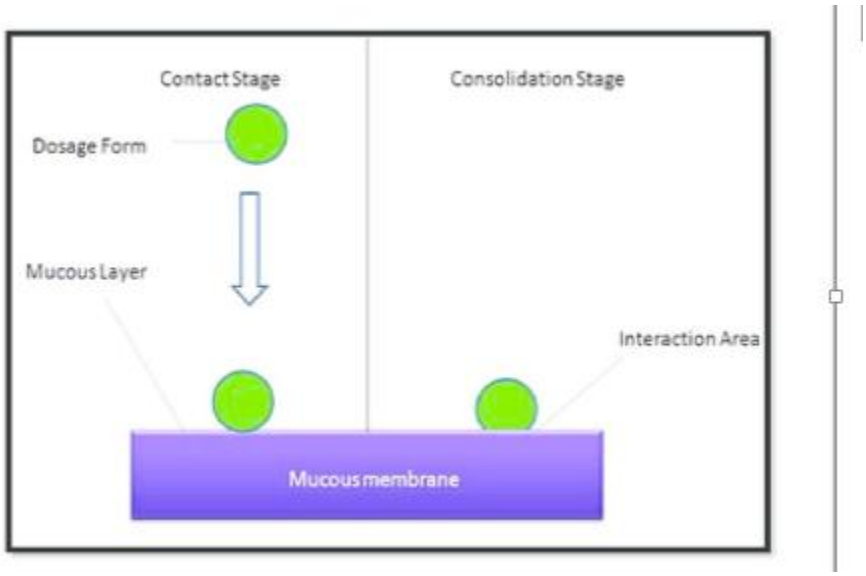


Figure 4. Stages of Muco-adhesion.

(4). Expandable System:

Increasing the dose form's size after ingestion is another method for extending the GRT[15]. They were initially applied for veterinary purposes before their uses were expanded to include humans[3]. Swelling needs to be larger than the sphincter's diameter. The pyloric sphincter's diameter varies from person to person; it is reported to be 12.8 7.0 mm, but because it is made up of muscles, During the migration of the myoelectric complex MMC, it can stretched and permit even the large dose forms to sphincter. The dose form should be larger than 20mm in size to prevent this flaw[15]. For the system to function well, three general configurations must be taken into account: small sized for simple oral administer, enlarged stomach form to avert pass into the pyloric sphincter, and this system size reduction after full release of drug to facilitate evacuation. Since this device can block the pyloric sphincter, it known as a "plug type system." expanding and unfolding, the two processes by which the system expands are those that allow for size and shape modification, respectively. Diffusion is the primary process for swell and meds release from the body these systems make use of hydrophilic polymers, such as carbopol, HPMC and polyethylene oxide, which can take up water from the gastric secretions and expand the system's volume[30]. The polymer and medication are folded or compressed inside the gelatin capsule in the unfolding systems. Gelatin is dissolved as it comes into touch with stomach fluid, releasing the enlarged shape that is mechanically desired[3].

(5). Super-porous hydrogel systems:

A 3-D strcucture of a hydrophilic polymer called a super porous hydrogel has interconnected microscopic holes that allow it to quickly and efficiently absorb enormous amounts of water. It may take several hours for the ordinary hydrogels to achieve equilibrium, at which point hydrogels with a high porosity with pore sizes more than 100 micrometres can be produced[18]. They are extremely porous systems that are more porous than typical swelling-type systems[15]. The swelling of SPHs, a new type of hydrogel with several large internal holes, usually happens by capillary wetting rather than diffusion[11]. Due to capillary wetting's quick absorption of water through linked, many open holes Through the co-formulation of hydrophilic particle materials, they are made to have enough mechanical strength to withstand the pressure caused by contraction of the stomach as they swell massively[8]. SPHs are made by mixing a number of components into diluted monomer water, including as initiators, cross linkers, foam stabilisers, foaming aids, and foaming agents. In addition to having a high capacity for swelling, biodegradability, biocompatibility, slipperiness, mechanical toughness, and stability in stomach acid, super porous hydrogels also have quick swelling[11].

(6). Magnetic system:

This method is based on the simple idea that each dosage type contains a tiny internal magnet, and the magnet is placed to the abdomen over stomach region. Use of an extracorporeal magnet can extend the dosage form’s stomach residence time[7]. To extend the GRT of acyclovir Peroral acyclovir depot tablets with internal magnetic materials have been developed. Using an external magnet, the dosage forms stomach residence times and the duration of acyclovir absorption were both lengthened[31]. The extra-corporal magnet risen the mean area under the plasma concentration time curve (AUC0-24h) of the 200 mg acyclovir-containing magnetic depot tablets from 1598.8 ng/ml.h when it was not present to 2802.7 mg/ml[15].

Future Prospective Of Grrds:

Drug release profile management has long been a primary goal in research and development in Pharmaceuticals. Attempting to control GI transit profiles

has taken centre stage over the last two decades and may lead to development of new products with novel therapeutic potential and significant patient benefits over the next two decades[32]. Novel gastro retentive drug products with 24 hour absorption and discharge phases may soon displace so called ‘‘once-a-day’’ formulations[19].

According to several recent papers, floating dosage forms have a wide range of future potential:

1. Delayed stomach emptying causes less fluctuation in the drug's plasma level.
2. The drugs bearing low bioavailability due to poor absorption in uppermost GIT is effectively administered to improve absorption and raise the absolute bioavailability[33].
3. The buoyant delivery system is an effective method for treating gastric and duodenal cancers
4. The floating idea can also be used to create different anti-reflux compositions[34].
5. Creating a controlled release method for medications that could be used for treatment of Parkinson’s disease as to investigate the possibility of eliminating H.pylori with antibiotics with a limited spectrum[20].

2. Conclusion

A growing no. of DDS will be created for optimizing distribution of the compounds showing regional diversity in drug absorption as per our comprehension of the influence of GIT physiology on drug delivery is growing. GRDDS can be used to modify the solubility and absorption of an oral given dose form. Regardless of the fact that a number of GRDDS, including bio-adhesive/mucoadhesive, magnetic, systems with variable density, are being described into literature and clinical significance has to be investigated. Future GRDDS approaches may need to concentrate on a combined strategy in order to improve product quality from a pharmacological perspective.

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