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Review Article

Floating Drug Delivery System: A Review

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ABSTRACT

Since they can enhance the effectiveness of controlled release systems, gastroretentive dosage forms (GRDF) are receiving a lot of interest today. A system that remains in the stomach for a long enough period of time while overcoming all physiological obstacles, releases the active portion in a regulated manner, and is ultimately easily metabolised by the body is referred to as an ideal GRDF system. Developing an effective GRDF is hampered by physiological constraints including stomach motility and gastric retention time (GRT). Different technologies, including high density systems, floating drug delivery systems (FDDS), mucoadhesive systems, expandable systems, superporous systems, and magnetic systems can be developed to increase gastroretention. Each of these systems has advantages and disadvantages of its own. This assessment concentrated on the numerous elements important to the growth of GRDF, includes the most recent developments and trends.

INTRODUCTION

The most practical and preferable method of delivering any medicine to the systemic circulation is oral administration. The pharmaceutical industry has recently shown an increased interest in oral controlled release drug delivery to gain better therapeutic benefits, such as simplicity in administering doses, patient compliance, and formulation flexibility. Drugs that are swiftly removed from the systemic circulation and have short half-lives are those that are easily absorbed

from the gastrointestinal tract (GIT). These medications must be dosed frequently to get the desired therapeutic effect. The development of oral sustained-controlled release formulations is an effort to bypass this restriction by slowly releasing the drug into the gastrointestinal tract (GIT) and maintaining an effective drug concentration in the systemic circulation for an extended period of time. Following oral administration, such a medication delivery method.(1)

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Physiology of stomach:

The stomach is separated into three parts anatomically Fundus, Antrum (pylorus), and Body. The closest part produced The GRDDSs (gastro retentive drug delivery system) are one innovative method in this field. GRDDs are dosage forms that can be retained in the stomach. By constantly releasing the drug for a lengthy time before it reaches its absorption site, GRDDSs can enhance the controlled delivery of medications with an absorption window.[2] In order to achieve therapeutic benefits from drugs that are absorbed from the proximal part of the GIT (gastro intestinal tract), are less soluble in alkaline pH, are degraded by it, or come into contact with at the lower part of the GIT, it may be desirable to prolong the gastric retention of the drugs. GRDDS are advantageous for such medications by enhancing their.[3]

- Bioavailability
- Therapeutics efficiency and
- Possible reduction of the dose.
- Maintenance of constant therapeutic levels over a prolonged period and thus reduction in fluctuation in the therapeutic levels
- Reduce drug wastage
- Improves solubility of drugs that are less soluble at high pH environment (e.g. weakly basic drug like domperidone, papaverine)

Whereas the antrum is the primary location for mixing motions and serves as a pump for stomach emptying by thrusting actions, the fundus and body operate as a reserve for undigested materials. Both when one is fasting and when one is eaten, the stomach empties. Inter-digestive myoelectric

cycle (IDMC) or migrating myoelectric cycle (MMC) are electrical events that occur during the fasting state and cycle through the stomach and intestine every 2-3 hours.[4]

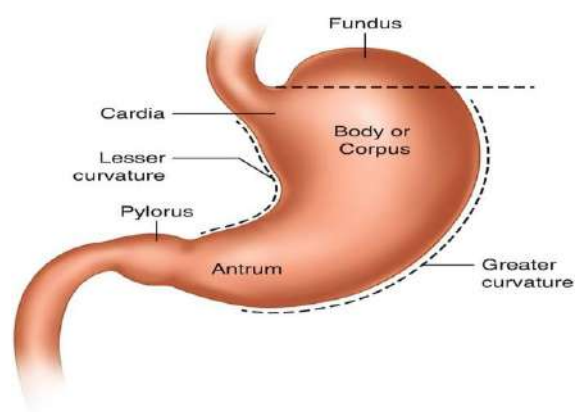


Fig no 1 Physiology Of Stomach Floating Drug Delivery System (FDDS)

To keep pharmaceuticals in the stomach, floating drug delivery systems (FDDS) were developed. These devices are useful for medications that have poor intestinal fluid solubility and stability. Making the dose form less dense than the gastric juices allows it to float on them, which is the principle underpinning FDDS. FDDS are hydrodynamically controlled low-density systems that have enough buoyancy to float over the contents of the stomach and stay buoyant there without significantly slowing down the gastric emptying process. With the drug's release, the stomach's residual system is emptied. As a result, the stomach residence duration is prolonged and the changes in plasma drug concentration are effectively managed. The concept of buoyant preparation offers a straightforward and useful method to boost stomach capacity.[5]

Classification of Floating Drug Delivery Systems

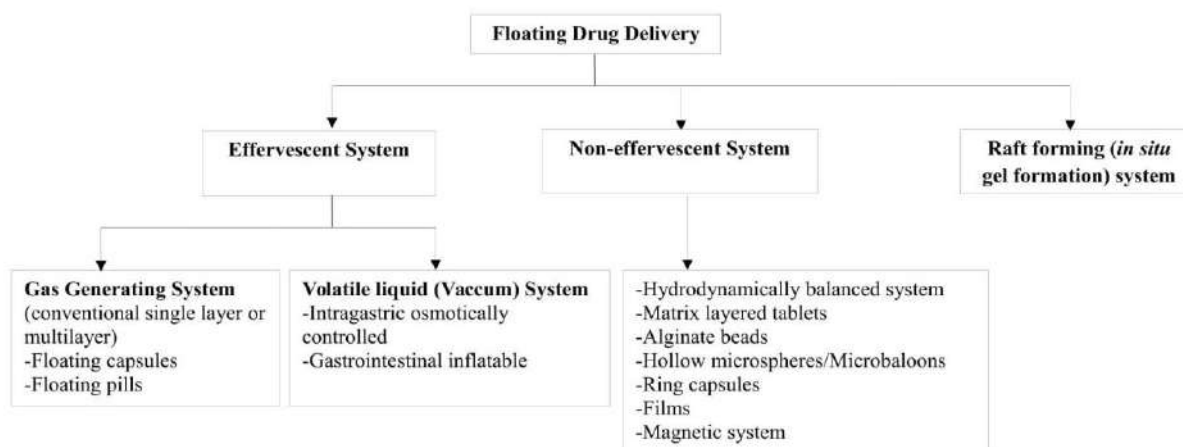


Fig no 2 Classification of Floating Drug Delivery Systems

A. Effervescent system Floating Drug Delivery System

These specific drug delivery systems are composed of polymers that can swell, such as chitosan and methylcellulose, as well as effervescent substances, such as citric acid, tartaric acid, and sodium bicarbonate. These are designed in such a way that when they come into touch with stomach juice, CO_2 is released and trapped in a swelling hydrocolloid, which gives the dosage form buoyancy. The distribution system's foundation is a technique that uses three swellable, asymmetrical layers of tablets. [6]

1. Gas generating systems:

Low-density FDDS is based on the release of CO_2 following oral delivery upon interaction with gastric juices. The substances are designed so that after they enter the stomach, CO_2 is released as a result of an interaction with the acidic gastric content and becomes retained in the gel-based hydrocolloid (fig. 2). It causes the dose form to rise while maintaining its buoyancy. In the end, it results in a decrease in the dose form's specific

gravity, which causes it to float on the chime. To create a gas-producing mechanism in the hydrocolloid layer of the tablet matrix, the CO_2 generating components are combined in a single layer or several layers, and the medication is present in the other layer, which has the effect of a prolonged release.[7]

2. Volatile liquid containing systems:

A gadget made of a hollow deformable unit in convertible compressed state makes up this osmotically controlled floating system. Internally divided into a first and second chamber and separated by an impermeable, pressure-sensitive movable unit, the housing would be attached to its deformable unit. A volatile liquid, such as cyclopentane or ether, becomes vaporised in the second chamber at a physiological temperature to form a gas, allowing the drug reservoir to float. The first chamber typically contains an active drug. With the aid of a bioerodible stopper that allowed the vapour to escape, the unit is ejected from the stomach. [8]

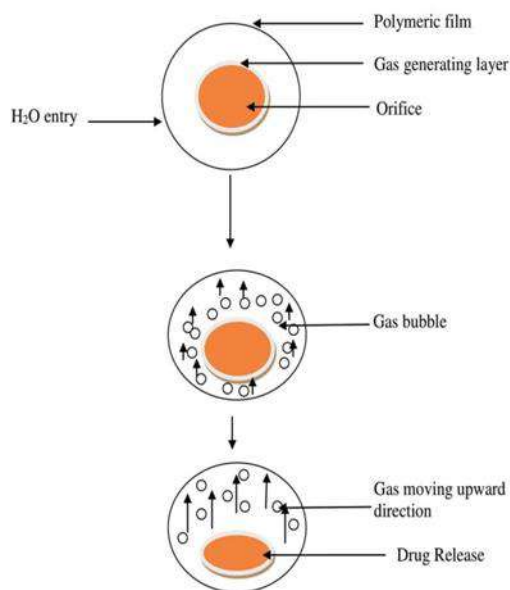


Fig no 3 Mechanism of floatation via CO₂ liberation

B. Non-effervescent Floating Drug Delivery System

Non-Effervescent Floating Drug Delivery Systems include cellulose hydrocolloids that can swell and form gels, as well as matrix-forming polymers including polycarbonate, polymethacrylate, and polystyrene. The standard method of formulation entails combining the drug with hydrocolloids that form gel upon oral administration and maintain the integrity of shape and a bulk density barrier; the air trapped by the swollen polymer gives the dosage forms buoyancy. [9]

1. Colloidal gel barrier systems (Hydrodynamic balanced systems)

This technique increases the amount of medicine that is delivered in solution form to the absorption site while extending stomach retention duration. Essentially, it includes medication with hydrocolloids that create gels to last buoyant from the food in the stomach. One or more

hydrocolloids of the cellulose type that produce gels, such as hydroxypropyl methylcellulose (HPMC), polysaccharides, and matrix-forming polymers like polycarbophil, polystyrene, and polyacrylate are included in such a system. The hydrocolloid in the system hydrates to produce a colloid gel barrier to its surroundings when it comes into touch with gastro-intestinal (GI) fluid. [7]

2. Microporous compartment systems

This method has pores on the top and bottom sides and encapsulates a drug reservoir inside a microporous compartment. To avoid any direct contact of the stomach surface with the undissolved medication, the peripheral wall of the drug reservoir compartment is entirely sealed. The delivery system floats over the gastric content in the stomach thanks to the air-filled flotation chamber. To the extent that it stops the drug from existing and carries the dissolved medication for continuous transit across the gut for absorption, gastric fluid enters through the aperture through which it passes. [9]

3. Floating Microspheres/Micro balloons

Hollow microspheres, commonly referred to as micro balloons, are thought to be the most effective buoyant device. It is made up of the microsphere's central hollow area. By using a unique solvent diffusion process for emulsion, hollow microspheres are created that are loaded with a medicine in their outer polymer shell. [8]

4. Alginate beads/Floating beads

Calcium alginate spherical beads with a diameter of approximately 2.5 mm have been used to create multi-unit floating dosage forms. These beads can be made by mixing sodium alginate solution into an aqueous solution of calcium chloride, which causes calcium alginate to precipitate. The calcium alginate precipitate is then separated from the beads, which is followed by snap-freezing them in liquid nitrogen and freeze-drying them at 400 °C for 24 hours to create a porous system. These

floating beads offer a longer residence period of more than 5.5 h, and thus constructed system would maintain a floating force for over 12 h. [6]

C. Raft-forming systems

For the administration of antacids and medications for gastro-intestinal infections and illnesses, raft-

forming systems are receiving a lot of interest. A gel-forming solution expands when it comes into touch with gastric fluid, creating a thick, cohesive gel that is trapped with CO₂ bubbles that create a raft layer on top of the gastric fluid and helps the drug release slowly in the stomach. [9]

Table 1 List of drugs explored in floating dosage forms

Types of dosage forms	Drugs explored in floating dosage forms
Floating Microspheres	Aspirin, Griseofulvin, P-nitroaniline, Ibuprofen, Ketoprofen, Terfenadine, Tranilast
Floating Granules	Diclofenac sodium, Indomethacin, Prednisolone
Films	Cinnarizine, (capsules)
Floating Capsules	Chlordiazepoxide HCl, Diazepam, Furocemide, L-Dopa and Benserazide, Misoprostol, Nifedipine, Propranolol HCl, Ursodeoxycholic acid
Floating Tablets/Pills	Acetaminophen, Aspirin, Amoxicillin trihydrate, Ampicillin, Atenolol, Captopril, Ciprofloxacin, Chlorpheniramine maleate, Cinnarizine, Furosemide, 5-Fluorouracil, Isosorbide mononitrate, Diltiazem, Isosorbide dinitrate, Nimodipine, Para amino benzoic acid, Prednisolone, Quinidine, Varapamil HCl, Riboflavin, Sotalol.
Films	5-Fluorouracil, Propranolol, Metoprolol
Alginate beads in-situ colloidal gel	Diclofenac sodium, Famotidine, Nevirapine, Riboflavin, Pantoprazole

Approaches to Design Floating Dosage Form High Density Systems

These systems, which have a density of around 3g/cm³, are kept in the stomach's rugae and strong enough to survive peristaltic motions. The main significant problem of these systems is that they are technically challenging to produce with a significant amount of medication (>50%) and attain the necessary density of 2.4–2.8g/cm³. To create such a high-density formulation, diluents like zinc oxide, titanium oxide, and iron powder must be employed (density = 4.9).[11]

Swelling and Expanding Systems

These systems also go by the name "Plug type system" because of their propensity to get stuck in the pyloric sphincters. Even in a fed condition, these polymeric matrices stay in the gastric cavity for several hours. Controlled and sustained medication release can be achieved by choosing a polymer with the right molecular weight and swelling characteristics. The polymer absorbs water when in contact with stomach fluid and

expands. Because there are physical and chemical cross connections in the hydrophilic polymer network, these polymers swell considerably.[12]

Incorporating Delaying Excipients

Feeding of digestible polymers or fatty acid salts that changes the stomach's motility pattern to a fed state, hence reducing the gastric emptying rate and allowing significantly longer medication release, is another delayed gastric emptying technique of interest. By including delaying excipients like trietanolamine myristate in a delivery system, it is possible to extend the GRT of a drug delivery system. [13]

Modified Systems

Systems with non-disintegrating geometric shapes that are extruded from polyethylene blends or moulded from elastic elastomers prolong the GRT based on the size, shape, and flexural modules of the drug delivery device.[14]

Mucoadhesive & Bioadhesive Systems

In order to improve drug absorption at a specific spot, bio adhesive drug delivery systems are



employed to localise a delivery device within the lumen. This method makes use of bio adhesive polymers, which can stick to the stomach epithelial surface. These systems have frequently used some of the most promising excipients, such as polycarbophil, carbopol, lectins, chitosan, CMC, and gliadin.[15]

Floating Systems

Floating drug delivery systems (FDDS) float in the stomach without slowing down the gastric emptying rate since their bulk density is lower than that of gastric fluids. The medicine is slowly withdrawn from the system at the desired rate while the body is floating on the contents of the stomach. The stomach's residual system is emptied following medication release. 22 A floating chamber with air, vacuum, or inert gas can be used to make a medication delivery system float in the stomach.[16]

Floating Drug Delivery Systems and Its Mechanism

Low density systems that have enough buoyancy to float above the contents of the stomach and stay there for a long time are called floating systems. The medicine is delivered slowly at the desired pace as the system floats over the contents of the

stomach, lengthening the gastro-retention period and minimising volatility. To maintain the dosage form consistently buoyant on the surface of the meal, however, a minimal amount of floating force (F) is also necessary in addition to the minimal stomach content necessary to allow the appropriate attainment of the buoyancy retention principle. A unique apparatus for calculating the resultant weight has been described in the literature to measure the floating force kinetics. The device works by continually measuring the force equal to F (as a function of time whatever is necessary to keep the submerged object in place. If F is on the upper positive side, as seen in fig., the item floats more effectively. This device aids in optimising FDDS with regard to the stability and longevity of the floating forces generated in order to avoid the negative effects of unforeseen fluctuations in intragastric buoyancy capability.[10]

$$F = F_{\text{buoyancy}} - F_{\text{gravity}} \\ = (D_f - D_s) g v \quad (1)$$

Where, F= total vertical force,

D_f = fluid density,

D_s = object density,

v = volume and

g = acceleration due to gravity.

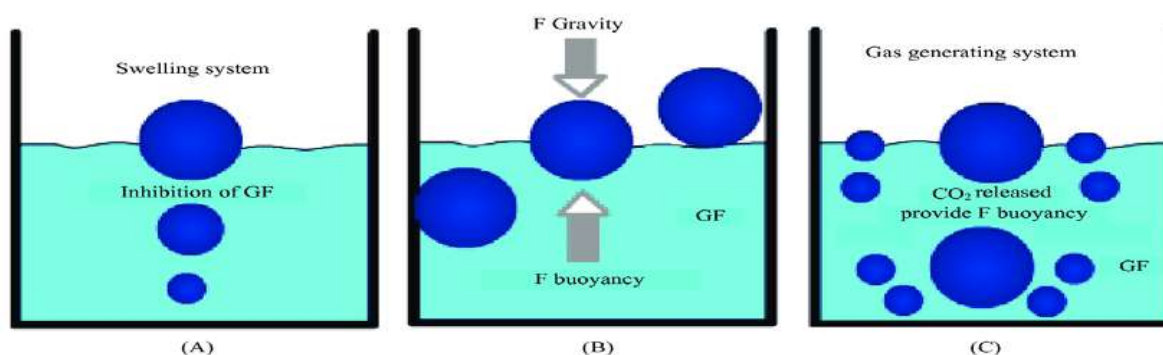


Fig.no 4 Mechanism of floating system

Factors Affecting Floating Drug Delivery System

a. Density:

The dosage form's density should be lower than that of the contents of the stomach (1.04g/ml).

b. Size:

A dosage form with a diameter more than 7.5mm spends more time in the stomach than one with a 9.9mm diameter.

c. Shape of the dosage form:

Compared to other devices of the same size, the tetrahedron stayed in the stomach for a longer time formulation with a single or more units. When compared to single unit dosage forms, multiple unit formulations exhibit a more predictable release profile and insignificant performance impairment caused by unit failure. They also allow coadministration of units with different release profiles or containing incompatible substances and permit a larger margin of safety against dosage form failure.

d. Fed or unfed state:

The gastric motility during a fast is characterised by bursts of vigorous motar activity that happen every 1.5–2 hours. The GRT of the unit can be relatively short if the time of the formulation and the MMC are the same, but in the fast state, the MMC is delayed and the GRT is prolonged because it sweeps undigested material from the stomach.

e. Nature of meal:

Feeding the stomach with indigestible polymers or fatty acids can cause the stomach's motility pattern to transition to a fed state, slowing down gastric emptying and extending medication release.

f. Caloric content:

GRT can be increased by 4-10 with a meal that is high in protein and fat.

g. Frequency of feed:

Due to the low frequency of MMC, the GRT can increase by more than 400 minutes when multiple meals are provided in comparison to a single meal.

h. Gender:

Regardless of height, weight, or body surface, the mean ambulatory GRT of males (3.4 hours) is lower than that of their age- and race-matched female counterparts (4.6 hours).

i. Age:

People who are older than 70 have GRTs that are noticeably longer.

j. Concomitant drug administration:

Opiates like codeine and anticholinergic drugs like atropine and propetheline can prolong GRT.[17]

Evaluation of Floating Drug Delivery System

a. Shape of tablets

Compressed tablets intended for FDDS are checked under a microscope to check for consistency in shape.

b. Tablet dimensions

According to official compendia, a calibrated Vernier calliper is used to measure the thickness and diameter of tablets in FDDS form, much like with traditional tablets. Three tablets of each formulation are chosen at random, and each tablet's thickness is measured.

c. Determination of hardness of the tablet

Using a hardness tester of the Monsanto type, randomly select 20 tablets from each batch of formulations should be used to determine the hardness.

d. Determination of weight variation

Twenty randomly chosen tablets are carefully weighed, and the average tablet weight is computed. The individual weight divergence from the average weight is then determined.

e. Determination of weight variation (Batch)

For each batch, ten tablets' individual crown to crown thickness is measured with slide callipers.

f. Measurement of floating capacity

Three separate tablets are placed in a flask with 400 ml of 0.1(N) HCL solutions. The duration of floating and the floating lag time, which are both measured in minutes, are the amount of time that it takes for a tablet to consistently float on the water's surface. After that, the sample mean and standard deviation are computed.

g. Measurement of the density of the formulation

The volumes and masses of the tablets are calculated in triplicate to determine their apparent densities. Using the mathematical formula for a cylinder ($V = A r^2 h$), the volume V of the cylindrical tablets is derived from their height h



and radius r (both measured with a micrometre gauge).

h. Determination of drug content in tablets

Randomly chosen from each batch, ten pills are added to a 100 ml volumetric flask that has been filled with 0.1(N) HCL. Take 1 ml from the volumetric flask and transfer it to the test tube after stirring and setting it aside for two hours. After that, samples are filtered, appropriately diluted, and subjected to spectrophotometric analysis at an appropriate wavelength. [18]

i. In vitro dissolution study

The dissolving vessel held the tablet inside. 5 ml of the sample are taken at 1-hour, 2-hour, 3-hour, 4-hour, 5-hour, 6-hour, 8-hour, 10-hour, and 12-hour intervals, or at any additional intervals as required. After each sampling, 5 ml of the dissolving media were replaced with new, bringing the total amount of dissolution fluid to 900 ml. The mean values are depicted versus time in the release studies, which used "n" tablets. Each sample is examined with a UV visible spectrophotometer at its maximum wavelength in comparison to a reagent blank, and the corresponding concentration is calculated using the associated calibration curve. [19]

j. Buoyancy/Floating test

Measurements are made of the interval between the dosage form's introduction and the onset of buoyancy on the simulated stomach fluid as well as the interval during which the dosage form maintains buoyancy. Total floating time (TFT) is the amount of time that a dosage form remains buoyant after emerging on the surface of a medium, also known as floating lag time (FLT) or buoyancy lag time (BLT). [20]

k. Swelling study

By observing a dose form's weight rise or water intake, swelling behaviour can be determined. The rise in tablet diameter and/or thickness over time may serve as a proxy for the dimensional changes. The equation's definition of water uptake as a

percentage of weight gain can be used to measure it.

$$WU = (W_t - W_o) \times 100$$

Where,

WU = Water uptake

W_t = Weight of dosage form at time t.

W_o = Initial weight of dosage form. [20]

Advantages of Floating Drug Delivery System

With stomach retention behaviour, floating dosage devices are significant technological medication delivery methods that provide a number of benefits.

These advantages include

1. Even at the alkaline pH of the intestine, floating dose forms like tablets or capsules will stay in the fluid for extended periods of time.
2. FDDS dose forms help retain the medicine in a floating state in the stomach to get a substantially better reaction in cases of diarrhoea and forceful intestinal movement.
3. Because aspirin and other similar medications might irritate the stomach wall when they come into touch with it, HBS/FDDS formulations may be helpful when administering these medications.
4. Drugs absorbed through the stomach, such as ferrous salts and antacids, benefit from the FDDS. Higher GRT and the dosage form spending more time at the absorption site result in improved medication absorption.
5. Drug delivery under control. By slowly releasing the medication, it reduces mucosal irritation.
6. Treatment of digestive diseases such gastroesophageal reflux disease. [21]

Disadvantages of Floating Drug Delivery System

1. Drugs with GI tract solubility or stability issues are not suitable for floating systems.



2. These systems need a lot of fluid in the stomach to float and function well while delivering drugs clothing, water
3. Drugs that undergo significant first pass metabolism and are significantly absorbed throughout the gastrointestinal system may not be the best candidates. E.g. Nifedipine.
1. 4 The subject must be standing up straight for the medicine to remain in the stomach.
2. 5 The digestive state affects how long something stays in the stomach. Therefore, FDDS should be given after a meal.
3. 6 Unsuitable for use with medications that lead to stomach lesions, such as non-steroidal anti-inflammatory medicines. These systems do not significantly outperform traditional dose forms for pharmaceuticals, which are absorbed throughout the gastro intestinal tract, for medications that are unstable in the very acidic environment.
4. 7 The mucus on the stomach's walls is constantly renewing, which causes unpredictable adhesion.
5. 8 Quicker swelling characteristics are needed, and the system should fully swell considerably in advance of the gastric emptying time.
6. 9 The dosage form's level of hydration affects its ability to float.
7. 10 The physical integrity of the system is the most crucial and fundamental need for success in all of the aforementioned factor

Table 2: Conventional v/s Floating drug delivery system

Relative parameters	Conventional drug delivery system	Floating drug delivery system
Toxicity	High risk of toxicity	Very low risk of toxicity
Patient compliance	Low	Improved
Drugs with poor solubility and high pH	Not suitable for delivery of drugs with narrow absorption window in the Small intestine region	Suitable for delivery of drugs with narrow absorption window in the small Intestine region
Drugs acting locally acting in the stomach	Not much advantageous for drugs having rapid absorption through GIT	Very much advantageous of drugs acting locally in the stomach.
Dose dumping	No risk of dose dumping.	Possibility of dose dumping

Applications of Floating Drug Delivery System

- Long-term medication delivery Hydrodynamically Balanced System (HBS) type dosage forms release the drug over a prolonged period of time by remaining in the stomach for several hours and by lengthening the gastric residence time. These dosage forms have a bulk density less than one, are relatively large in size, and did not easily pass through the pylorus. Levodopa can be released from the Madopar HBS formulation for up to 8 hours in vitro, compared to less than 30 minutes for the regular formulation.
- Localised medication delivery Drugs like riboflavin, furosemide, and others that require specialised stomach or nearby small intestine absorption benefit most from floating drug delivery devices. It has been discovered that the stomach, followed by the duodenum, is the predominant location of captopril absorption. This characteristic led to the creation of a monolithic floating dosage form of captopril, which boosts bioavailability and results in a nearly 1.8-fold rise in AUC compared to regular tablets by extending the gastrointestinal residence duration.
- Improvement of absorption Potential candidates for formulation as floating drug delivery systems include medications with low absolute bioavailability since their

absorption is limited to the upper GIT. This would increase their absolute bioavailability.

- Reduced unfavourable colonic activity Drug retention at the stomach (HBS system) reduces the quantity of drug that enters the colon, preventing the drug's unwanted effects in the colon. For betalactam antibiotics, which are only absorbed from the small intestine and whose presence in the colon results in the development of microorganism resistance, this Pharmacodynamic feature gives the justification for GRDF formulation.
- H. Pylori, the bacteria that causes persistent gastritis and peptic ulcers. To keep the infection at the stomach mucosa infection site, patients need a high concentration of the medicine. Due to its capacity to float, the floating dose form was kept in the stomach and kept the drug's high concentration there. Sodium alginate was used to create a prolonged liquid preparation of ampicillin that binds to gastric mucosal surfaces, spreads out, and releases the medication constantly.
- For example, a floating system for furosemide could be used as a potential treatment for Parkinson's disease. Floating drug delivery systems are particularly helpful for drugs that are poorly soluble or unstable in intestinal fluids, acid stable drugs, and for those that undergo abrupt changes in their P H - dependent solubility due to pathophysiological conditions of GIT, food, and age. After oral delivery, the medication was absorbed in the body by about 30%. [22]

Limitation OF Floating Drug Delivery System

1. These systems need a lot of water in the stomach to float and function properly while delivering drugs.

2. Not suited for medications with GIT solubility or stability issues.
3. It would not be advisable to take medications like nifedipine, which is well absorbed throughout the GIT and undergoes first pass metabolism.
4. Drugs that irritate the gastric mucosa are also undesirable or inappropriate.
5. Drug compounds that are unstable in the stomach's acidic environment are not good choices to be added to the systems.
6. A full glass of water (200-250 ml) should be consumed with the dose form. [23]

Drug Suitable for Floating Drug Delivery System

1. Substances that operate locally in the stomach, such as antacids and misoprostol, etc.
2. Medicines have a limited window of absorption in the gastro intestinal system, such as riboflavin, furosemide, etc.
3. Drugs that exhibit instability in the intestinal environment, such as captopril, ranitidine HCl, etc.
4. Medicines that work well against common intestinal microorganisms, such as antibiotics for *Helicobacter pylori*.
5. Medicines that are poorly soluble at high pH levels, such as chlordiazepoxide, diazepam, etc.

Drugs Unsuitable for Floating Drug Delivery System

1. Drugs whose solubility in the acid media is very low, such as phenytoin, etc.
2. Drugs that are unstable in the conditions of the stomach, such as erythromycin, etc.
3. The drugs, such as corticosteroids and 5-amino salicylic acid, that are primarily used for their selective release in the colon. [24]



Patents for some Floating Gastro-Retentive Delivery

US patent No	Patent title
5,972,389	Gastric-retentive, oral drug dosage forms for the controlled release of sparingly soluble drugs and insoluble matter
5,443,843	Gastric-retention system for controlled drug release.
5,232,704	Sustained-release, bilayer buoyant dosage form.
5,169,638	Buoyant controlled-release powder formulation.
4,814,179	Floating sustained-release therapeutic compositions.
4,767,627	Drug delivery device that can be retained in the stomach for a controlled period of time.
4,167,558	Novel sustained-release formulations.
4,140,755	Sustained-release tablet formulations.
4,126,672	Sustained-release pharmaceutical capsules.
0013876 A1	Novel floating dosage form.
6,685,962 B2	Gastro retentive controlled release pharmaceutical dosage form.
6,207,197 B1	Gastro retentive controlled release microspheres for improved drug delivery.
6,120,803	Prolonged release active agent dosage form adapted for gastric retention
0180086 A1	Gastroretentive levodopa delivery dosage form.

Marketed Products of FDDS

Sr. No.	Brand name	Drug (dose)	Company, country	Remarks
1	Modapar®	Levodopa(100 mg), Benserazide(25 mg)	Roche products, USA	Floating cr capsule
2	Valrelease®	Diazepam(15 mg)	Hoffmann laroche, USA	Floating capsule
3	Liquid gavison®	Al hydroxide (95 mg), mg carbonate (358 Mg)	Glaxo smith Kline, India	Effervescent Floating liquid Alginate Preparation
4	Topalkan®	Al-mg antacid	Pierre fabre drug, France	Floating liquid Alginate Preparation
5	Convion	Ferrous sulphate	Ranbaxy, India	Colloidal gel Forming FDDS
6	Cifran od®	Ciprofloxacin (1gm)	Ranbaxy, India	Gas-generating Floating tablet
7	Cytotec®	Misoprostal (100 Mcg/200 mcg)	Pharmacia, USA	Bilayer floating Capsule
8	Oflin od®	Ofloxacin (400mg)	Ranbaxy, India	Gas generating Floating tablet
9	Glumetza	Metformin hydrochloride	Depomed	Gas-generating Floating tablet

CONCLUSION

In order to increase bioavailability and provide controlled release of the dose form, formulation of FDDS is an effective and promising method. The

density of the dosage form must be smaller than that of stomach fluid, which is the most crucial factor to consider when formulating an FDDS.



It can be said that these dose forms are the most useful for treating GIT-related illnesses and getting a long-lasting effect out of a medicine with a short half-life. Many businesses are working to commercialise this approach despite the numerous challenges that must be overcome to achieve prolonged gastric retention. Number of patents and commercial items.

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