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Floating Drug Delivery System of Gastro Retentive Drug Delivery System

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KEYWORDS

Floating Drug Delivery Systems; Gastro Retentive Drug Delivery Systems; Classification; Methods; Evaluation

ABSTRACT:

Short stomach residence times and erratic emptying of the stomach times are among the physiological problems that have been resolved in recent years by scientific and technological breakthroughs in the study and creation of novel drug delivery techniques. Gastro-retentive drug delivery refers to dosage forms that are able to remain in the stomach. Some methods used to prolong the gastric residence period include swelling and expanding systems, floating drug delivery systems, polymeric bio-adhesive systems, high-density systems, along other delayed gastric emptying systems. The latest phase of medication-based therapy is emerging, wherein an increasing number of innovative drug delivery techniques are being utilized to render drugs appropriate for clinical application. Floating Drug Delivery Systems (FDDS) are among the most efficient gastro-retentive dosage forms used to provide an extended period of stomach gastric residence. The goal of this review was to compile the most recent studies on floating drug delivery systems (FDDS), with a particular emphasis on the primary floating mechanism that causes gastric retention. Long-acting oral dosage forms of medications that act locally all over the stomach and are absorbed from the upper part of the gastrointestinal tract have many benefits. The physiology, excipient variables that affect gastric retention, factors governing the duration of gastric retention, and methods for creating hydro- dynamically balanced single- and multi-unit floating structures are all covered in this review, an in-depth explanation of their classification, development, and assessment; and a few instances of how these systems are used.

1. Introduction

The drugs of drug delivery systems are made of pure, unadulterated crude drug form, which can be solid, semi-solid, or liquid. These systems should be safe, stable, and effective in treating a patient's condition, delivering the drug of the proper amount to the particular place in the body easily, achieving the actual concentration, and maintaining that concentration [1]. The majority of methods for delivering drugs that are developed are oral ones. It is usually advised to administer medications orally because it is easier to administer, less expensive to treat, and increases patient compliance [2]. Despite a medication's many benefits, because it is easily expelled from the stomach, the amount and duration of the dosage should be increased [3].

To get beyond these obstacles, the way drugs are distributed needs to permit prolonged stomach residence [4]. Gastro-retention reduces drug waste, extends the time of drug release, increases bioavailability, and enhances drug solubility which makes a medication less soluble in a high environmental pH [5]. Several drugs work best when given in this manner because their release is continuously regulated and delayed in the stomach [6]. With this type of drug delivery method, there might be no require for repeated dosage and a great reduction in adverse effects. [7]. The packaging of medications in multi-layered or bi-layered tablets is one innovative

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way to provide both the loading as well as the maintenance dosage in a tablet for pharmaceutical dosing [8]. With the medication released immediately in a single layer and released gradually in a second layer, Because of its design, extended-release medications can be produced and kept at a higher blood level for longer.

[9] .After absorption, the section of the immediate release will dissolve quickly, providing the initial dosage of medication for immediate action [10]. During this process, the matrix layer mostly stays in place as it passes through the intestine, gradually dissolving in the exposed phases to help keep the blood level at the starting point [11].

There are various challenges in designing controlled release systems for enhanced absorption and bioavailability. One of these difficulties involves restricting how much medication can form in the targeted gastrointestinal tract area [12]. Drug absorption from the digestive tract is a complex and unpredictable process. [13]. It is commonly known that contact time with the small intestinal mucosa influences the amount of drug absorption in the gastrointestinal system [14]. Therefore, small time for gastrointestinal transit is a crucial factor to take into account for drugs that are not completely absorbed [15]. A synopsis of fundamental human physiology is given, along with details on motility patterns, stomach emptying, along with formulation and physiological factors that influence it. [16]

Generally, oral administration of traditional controlled-release dosage forms results in a delayed beginning of action and a prolonged release of the medication [17]. Accordingly, the layered tablets have a pharmacokinetic advantage over conventional controlled-release dosage forms since the drug's plasma is continuously released from the immediate release section of the tablet as soon as the medication is swiftly delivered from the sustained-release layer. [18]

Adequate medication for stomach-retentive drug delivery systems: [19-21]

- Stomach medication that acts locally, such as antacids, misoprostol, etc.
- Drugs like riboflavin and furosemide that have a restricted window of absorption in the gastrointestinal tract.
- Drugs that are not readily soluble at high pH values, like Benzodiazepines and Chlordiazepoxide
- Medications those are unsuitable in the colon, such as Ranitidine HCl, Captopril, etc.
- Antibiotics against *Helicobacter pylori* are examples of effective medications against common colonic bacteria.

Drug not appropriate for use in gastro-retentive drug delivery systems: [22-24]

- Medications that cause environmental instability in the stomach, such as erythromycin
- Mainly by using medications to release them in the colon in a targeted manner. For instance, 5- amino salicylic acid and corticosteroids
- Medications with extremely low solubility in acidic media, such as Phenytoin.

Basics of gastro-intestinal tract physiology

The three anatomical regions that make up the stomach areThe fundus,

- The body,
- The antrum (pylorus) [25]

Undigested material is held in reserve by the fundus and the proximal portion's body.

The main site of mixing motions and the pumping action that propels food out of the stomach occurs in the antrum [26].

Stomach Physiology: [27-29]

The stomach is the portion of the digestive tube that is larger and located between the small intestine and the esophagus. The stomach contracts when it empties, raising the mucosa and sub-mucosa into distinct folds called rugae. Four primary types of secretory epithelial cells cover the exterior of the stomach, in addition to the gastric pits and glands.

- **G cells:** These secrete the gastrin hormone.
- **Parietal cells:** These secrete the hydrochloricacid.
- **Mucous cells:** These secrete the alkaline fluid.

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- **Chief cells:** These secrete the proteolytic enzyme, pepsin.

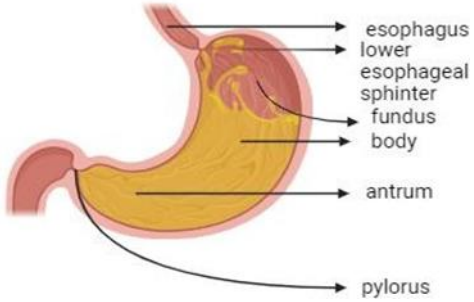

Figure 1: Stomach PhysiologyGastric motility:

Gastric motility is regulated by a sophisticated web of hormonal and neurological messages. [30]

Gastric empty rate:

Both when feeding as well as fasting, gastric emptying occurs. Nonetheless, the motility patterns in the two states differ [31]. Every two or three hours, While fasting, an internal digestive series of electrical events takes place in the digestive tract and intestines. This is known as the Mylo-electric Migratory Cycle or Inter-digestive Mylo-electric Cycle (MMC) [32]. As per Wilson and Washington, this is classified into the following four phases:

- Phase I /basal phase :

There are irregular contractions during the 40–60 minute duration.

- Phase II /Preburst phase :

It has erratic contractions and an action potential that lasts for 40 to 60 minutes. As the phase progresses, both the level of frequency and intensity gradually increase.

[33]

- Phase III /Brust phase :

The duration is 4 to 6 minutes. It is made up of rapid, forceful contractions that happen repeatedly. Using this wave, all of the undigested food is transported from the stomach into the

small intestine. This is called as House-keeper wave [34].

- Phase IV :

Throughout Phase III and I which consists of two successive cycles, it persists for 0 to 5 minutes. [35].

The contraction pattern shifts from the fasted to the fed condition following the consumption of a mixed meal. This pattern, sometimes referred to as the digestive motility pattern, consists of ongoing contractions similar to those in phase II of the fasting state [36]. Food particles are reduced in size by this contraction to less than 1mm, and then they are sent in a suspension state in the direction of the pylorus. The delayed start of MMC during the fed state causes the rate of stomach emptying to slow down [37].

Two primary complications are linked to controlled-release dosage forms that are administered orally: Studies using scintigraphy for determining gastric emptying rates have shown a short gastric residence period and an irregular gastric emptying rate. [38, 39]

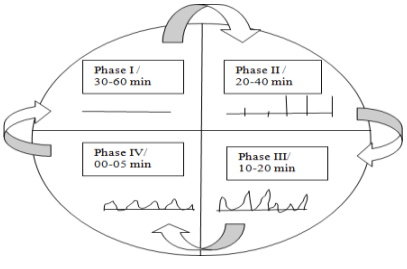

Figure 2: Motility pattern in GIT

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Categorization of Gastro Retentive Drug Delivery System: [40-46]

The dosage forms known as Gastro Retentive Dosage Forms (GRDF) are designed to remain in the stomach.

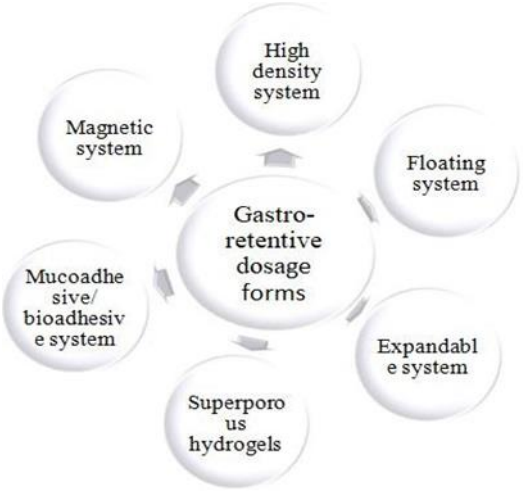

Figure 3: Types of Gastro Retentive Dosage FormsHigh-density System:

With an average density of -3g/cm^3, these GRDF types are stored in the stomach rugae. The lower stomach can support these systems above its maximum threshold density of 2.4–2.8g/cm^{3}The primary disadvantage of it is that it is technically difficult to produce them with a large number of medicinal products.

Magnetic system:

Additionally to an extra-corporal magnet, the magnetic dosage forms also contain an internal little magnet that controls the dosage forms' gastrointestinal transit. In terms of technique and formulation, the Floating Drug Delivery system is a remarkably easy and sensible method for creating GRDF.

Mucoadhesive/ bioadhesive system:

These systems enable the integration of bioadhesive agents, which prevent gastric emptying by enabling the system to stick to stomach cell walls. By enhancing the intimacy between the bio-adhesive systems and the GRT is extended, the duration of contact between the dosage forms and the biological membrane of the gastric epithelial cell or mucin.

Super-porous hydro-gel:

These systems have an average pore size of more than 100µm, making them swellable. Due to the water being absorbed quickly, they swell to a state of equilibrium in less than one minute through capillary wetting via multiple connected open pores. They expand in anticipation of providing enough mechanical strength to resist the pressure brought on by the contraction of the stomach.

Expandable system:

Typically, there are three configurations for expandable GRDF:

i. A tiny form that allows for easy oral intake.

ii. An expanded form that obstructs the stomach'spyloric sphincter as it passes through it.

iii. The stomach completes this final, minusculeform when accumulation is no longer required.

Osmosis is typically responsible for swelling and mechanical shape memory which induces the unfolding.

Floating system:

Floating drug delivery systems also known as Hydro-dynamically balanced systems, are low-density systems with enough propensity to float over the contents of the stomach and stay there for a long time, releasing the drug component at the desired rate. This increased gastro-retention time and decreased fluctuation are also benefits of the system's ability to float over the contents of the stomach. The pharmacokinetic release rate of a drug to a particular region is controlled using the FDDS

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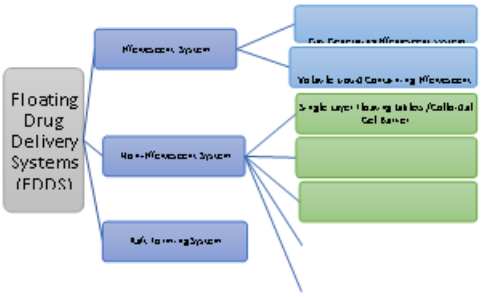
mechanisms, a gastro-retention drug delivery system, to produce the desired pharmacological effect.

Factors controlling the Gastric retention time of a Dosage form: [47, 48]

- Age
- Gender
- Type of meal
- Density
- State of being fed or unfed
- Concurrent use of drugs
- Size and shape
- Frequency of feed
- Posture
- Caloric content

Categorization of Floating Drug Delivery Systems (FDDS):

Floating Drug Delivery Systems come in three different varieties (FDDS) [49].



Bi-layer Floating Tablets

Microporous Compartment System

Hollow Microspheres /Micro Balloons

Alginate Beads /Floating Beads

A. Effervescent Systems:[50-54]

A floating chamber that is capable of being filled with air, water, vacuum, or inert gas is used in this system. Carbon dioxide (CO_2) can be added to the floating chamber as a result of the effervescing reaction between the bicarbonate/carbonate salts and organic acids (citric acid). This kind of system uses a matrix consisting of swellable polymers such as polysaccharides that resemble chitosan, effervescent substances like citric acid, tartaric acid, and sodium bicarbonate, and chambers that contain a liquid that becomes gaseous at body temperature.

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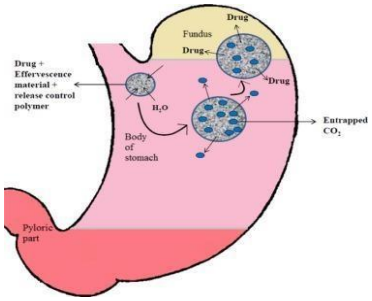

Figure 4: Effervescent Systems of GRDDS

Gas Generating Effervescent system:

This buoyant delivery system releases CO2, which minimizes its particular gravity and causes it to float over the chime thanks to the effervescence reaction between bicarbonate/carbonate salts and tartaric /citric acid.

Effervescent System Containing Volatile Liquid:

These have an inflated stomach chamber that gasifies a liquid (such as cyclopentane) and inflates at body temperature. The medication is kept in the system's first chamber, while the volatile liquid is kept in its second chamber.

B. Non-Effervescent FDDS: [55-59]

The gastrointestinal tract's non-effervescent FDDS functions by adhering to the mucosal layers or by swelling polymers. The excipients that are most frequently used in non-effervescent FDDS are:

Hydrocolloids based on cellulose that gel and swell considerably

Gums that are hydrophilic

Polysaccharides, matrix-forming substances like chitosan and carbopol, as well as bioadhesive polymers like polymethacrylate, polystyrene, polycarbonate, and polyacrylate

a) Single Layer Floating Tablets /Colloidal GelBarrier:

These systems include highly swellable cellulose-type hydrocolloids that form gels, polysaccharides of high concentrations, and matrix components that form polymers.

b) Bi-Layer Floating Tablets:

There are two layers in a bi-layer tablet:

i. The system's initial dosage is released by the immediate release layer.

ii. Stomach fluid is absorbed by the sustained release layer, which keeps the bulk density below 1 and creates a colloidal gel layer that isimpermeable on its surface.

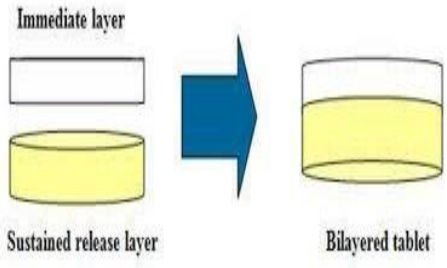

Figure5: Bi-Layer Floating Tablets

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c) Microporous Compartment System:

A microporous compartment containing holes in its upper and lower walls is supposed to be created using this type of technology to enclose a drug reservoir.

d) Hollow Microspheres /Micro balloons:

When submerged in aqueous media, for a full 12-hour period, hollow microspheres, also called micro balloons, were seen to float in vitro.

e) Multi-particulate system: Alginate Beads

/Floating Beads:

Oral dosage forms with numerous tiny, discrete units make up multi-particulate drug delivery systems

C. Raft Forming System:

When it comes to delivering antacids and additional treatments for digestive infections and disorders, raft-forming systems typically need to be into account. [60] A compact, viscous gel with trapped CO2 bubbles forms on the exterior of the gastric fluid in the stomach, allowing the drug to be released gradually by the gel-forming solution. This happens when gastric fluid comes into contact with the gel-forming solution. [61].

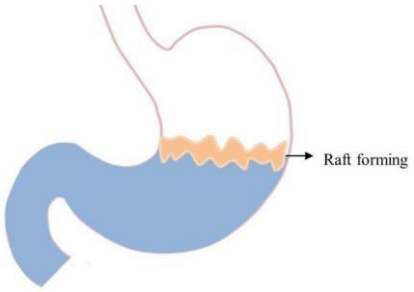

Figure 6: Raft Forming SystemMethods for Developing a Floating Drug Delivery System: [62-71]

1. For Single Unit Dosage Forms (Ex:Tablets):

- **Floating Lag Time:**

Measured in seconds or minutes, this is the amount of time that it requires for the tablet to surface on the dissolving medium.

- **Duration of Floating Time and *In-Vitro***

Drug Release :

This can be achieved by speeding up or slowing down the stirring of a simulation gastric juice at 37±0.2ºC of pH 1.2 without the use of pepsin by using a USP type II device of a paddle type of speed 50 or 100 rpm. Following that, the collected specimens are methodically gathered, and the quantity of drug content and are more soluble in acidic environments. The bulk density of the drugs in the form of a dose needs to be lower than "1". The medicine must be continuous for it in them is examined.

It is possible to visually observe the floating duration, which represents the number of hours the tablets float on the dissolving medium surface.

- ***In-Vivo* Assessment of Gastro-Retention**:

This is accomplished by employing gamma-scintigraphy or X-ray technology to test the dosage form transition in the GIT. Weight variance, hardness, etc are also examined for these tablets.

- **Hydro-dynamically Balanced System*:***

This floating drug delivery system is intended to enhance the gastrointestinal tract's ability to absorb some medication types and extend their half-lives. The HBS system produces drugs that have a preferred site of absorption in the upper part of the small intestinal tract to stay in the gastrointestinal tract for a prolonged amount of time.

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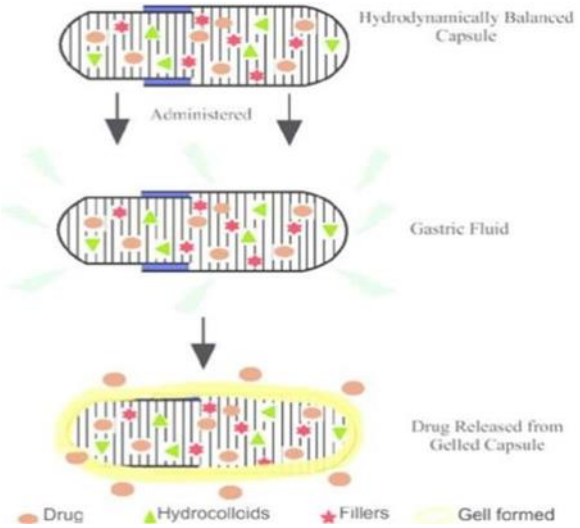

Figure 7: Hydro-dynamically Balanced System

For Multiple Units Dosage Forms, Such asMicrospheres:

Morphological And Dimensional Analysis:

Using scanning electron microscopy (SEM) to analyze dimensions and morphology. An optical microscope can also be used to determine the dimension.

In-Vitro Potential for Floating (Level ofbuoyancy):

A USP Type II dissolution apparatus filled with 900ml of 0.1 N HCl containing 0.002 level v/v Tween 80 is rotated at 100 rpm for 12 hours, and a known number of microspheres are dispersed across its surface. Following the time period of 12 hours, the layers that have settled and floated are separated, desiccated, and weighed. Using the following formula, the buoyancy is determined.

(%) Buoyancy = [Wf / (Ws + Wf)] * 100

Where,

W_S = the settled microspheres' weight

W_f = the weight of suspended/floated microspheres

Interactions between Drug and Excipient(DE):

Commonly, for the drug and excipients study FTIR is used. The appearance of a new peak or /and a disappearance of the prior drug or excipient peak are signs of the interaction between drug and excipient.

Techniques for Establishing a Floating Drugs Delivery System: [72-82]

Effervescent Technique:

With this drug delivery system, organic acid (i.e. citric acid) and bicarbonate salts will react effervescently to fill the floating chamber with inert gas (CO2).

Wet Granulation Technique:

It involves rubbing, grinding, or drying powder wet. Instead of compacting the powders, with the help of adhesive, wet granulation forms the granules by binding them together.

Direct Compression Technique:

It involves the compression of tablets straight fromtheir powdered form without altering the material's physical the structure. The most widely used carriers are Tri-calcium Phosphate, Di-calcium Tri-hydrate Phosphate, etc.

Solvent Evaporation Technique:

To remove all of the liquid dispersal solvents, the continuous phase's capability is inadequate. The hardened microspheres are received after the solvent evaporates from the dispersal surface.

Ionotropic Gelation Technique:

To create instantaneous microparticles, Calcium ions with opposing charges, or counter-ions, were used to gel the anionic polymer sodium alginate, which is the

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primary polymer derived from natural sources.

Spray Drying Technique:

Solidifying the covering by dissolving the coating material entails dispersing the core layer all through the compressed coating content and rapidly evaporating the core coating mixture.

Melt Granulation Technique:

The pharmaceutical powders are agglomerated in this process using a meltable binder; it doesn't require the use of organic solvents or water for granulation.

Technique of Melt Solidification:

This method is used to emulsify the molten mass in the aqueous phase and then cooled to solidify. This technique employs lipids, waxes, polyethylene glycol, and other carriers.

Sl. No.	Carr's index (%)	Hausner'sratio	Flow ability
1.	26-31	1.35-1.45	Poor
2.	21-35	1.26-1.34	Possible
3.	16-20	1.19-1.25	Fair
4.	10-15	1.12-1.18	Good
5.	0-10	1.00-1.11	Excellent

Specification for Carr's index and Hausner's ratio

Evaluation of the Drug Delivery System in Floating Form: [83-93]

Density in Bulk:

$DB = m / V_o$

It is the proportion of the powder's bulk volume (V_o) to its total mass (m).

Tapped Density:

$D t = m / V_i$

It is the proportion of the powder's total mass (m) to its tapped volume (Vi).

Index of Compressibility:

One way to assess a powder's flowability is to look at its tapped density and bulk density (ρo).

Compressibility Index = (ρt – ρo / ρt) × 100

Where,

ρo is the Bulk density of powder (g/ml) ρt is the Tapped density of powder (g/ml)

The Hausner Ratio:

The formula that follows is

Tapped densityHausner's Ratio =----------

Bulk density

By dividing the Tapped density by the Bulk density, it is calculated.

The angle of Repose :

For measuring the frictional forces in granules or loose powder, the angle of repose is a very useful tool. This is the largest possible angle between the surface of a granule or powder pile and the horizontal plane. Granules are allowed to pass through an opening at a preset height (h) that is attached to a stand. The angle of repose was then determined using the dimension and the radius of the granules heap that had formed.

Tan θ = (h/r)

-1

θ = tan (h/r)

Where,

θ represents angle of repose

h represents height of the heapr represents radius of the heap

The connection between powder flow and angle of repose:

Angle of repose	Powder flow
>40	Very poor
30-40	Passable
25-30	Good
<25	Excellent

Tablet Dimensions:

Using a calibrated Vernier Caliper, the thickness and diameter were measured. Each formulation's three

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tablets were taken randomly. And then the thickness of each tablet was determined independently.

Hardness of Tablets :

A tablet's hardness indicates how resistant it is to mechanical shocks when being handled. The tablets' hardness was evaluated with a Monsanto hardness tester. It was stated as kg/cm^2. The tablets' hardness was determined after three were chosen at random.

Friability Test of Tablets:

Tablet friability has been evaluated by using the Roche Friabilator. The percentage (%) has been used to express it. First, after weighing ten tablets (W), they were added to the friability. For four minutes, the friability was measured at 25 rpm or as much as 100 revolutions per minute. Once more, weighing the tablets has been done (Wo). Next, the formula was utilized to calculate the percentage of friability–

$$\%F = 100\ (1-Wo/W)$$

Less than 1% of tablets were deemed to have desirable friability.

Density of Tablet:

Tablet density was a great standard for floating tablets. The tablet worked best at floating when its density was much less than that of intestinal fluid (1.004). The following formula was used to determine the density.

$$V = \pi * r^2 * hd = m / v$$

Where,

v = volume of tabletm = tablet's mass

r = tablet's radius

h = tablet's crown thickness

Weight Variation Test of Tablet:

A total of ten tablets were chosen at random from every batch and weighed individually to look for weight variations. According to US Pharmacopoeia, A slight amount of variation in a tablet's weight was permissible.

Weight variation percentage deviation:

Percent deviation	**The average weight of a tablet**
5	324 mg and more
7.5	More than 130 mg and less than 324mg
10	130 mg and less

Calculating the buoyancy lag time:

The buoyancy lag is the amount of time it takes for the tablet to come out towards the surface and float.

The buoyancy of tablets was investigated in 900 millilitres of gastric-simulation fluid at 37±0.5ºC. The buoyancy lag time was measured with a stopwatch, and the entire floating time was visually observed.

Floating time:

The floating time was determined using 900 millilitres of 0.1N HCl and a USP dissolution apparatus type-II running at 50 rpm. Throughout the study, A constant temperature of 37±0.5ºC was maintained. By using visual observation, the duration of the tablet's float in the dissolving agent (such as floating lag time, which is the duration of time that it takes for the tablet to surface) is known as floating time.

Swelling Index of Tablet:

For the tablets that included the floating long-lasting release layer, a swelling examination was conducted. After the accurately measured tablets had been placed in the United States Pharmacopeia and dissolution apparatus type-II, which contained 900ml of 0.1N HCl at the temperature of 37±2ºC that they swelled until their weight stabilized. We removed the tablets, blotted them using filter paper, and noted any weight variations. For every experiment, three duplicates were conducted. The swelling index, or degree of swelling, was then computed using the formula.

$$\text{Swelling Index of Tablet} = [(W_g - W_o) \times 100] / W_o$$

Where,

Wg = the tablet's weight at equilibriumswelling in the medium

Wo = the tablet's initial weight.

Drug content of Tablet:

Five tablets at random were selected from a batch, weighed, as well as ground in a mortar and pestle to a powder. After carefully weighing 100 mg of granulated tablets, the volume of a standard flask was then filled

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using 0.1 N HCl. The solution was run through a membrane paper filter with a 0.45 µm thickness. Through the use of the spectro-photometric technique, analysis was completed.

temperature of 37 ± 0.5°C using 900 ml of 0.1N HCL. For 12 hours, every hour, a sample of the solution (5 milliliters) was taken out of the dissolving apparatus and replaced with fresh dissolving medium. The absorption rate of the solutions was computed following the passage of the specimens through Whatman's filter paper.

Excipients Added to Multiple Floating Dosage Forms: [94]

- **Effervescent Agents:**

E.g. Sodium Bicarbonate, Citroglycine, Disodium Glycine Carbonate, Tartaric Acid Citric Acid etc.

- **Release Rate Retardants:**

E.g. Talc, Magnesium stearate and Dicalcium phosphate etc.

- **Inert Fatty Materials:**

E.g. Fatty acids, Beeswax etc.

- **Hydrocolloids:**

E.g. Gelatin, Acacia, Alginates, Pectin,carbopol, Hydroxy-propyl Methyl Celluose etc.

- **Release Rate Accelerants:**

E.g. Mannitol, Lactose etc

- **Buoyancy Increasing Agents:**

E.g. Polypropylene Foam Powder and EthylCellulose.

The Advantages of the Floating Drug Delivery System: [95]

- FDDS can linger in the gastrointestinal tract for several hours, extending the period that various drugs are retained.
- Advantageous for drugs meant to act locally in the stomach As an example, antacids.
- FDDS formulation is beneficial for diarrhea and intestinal motility because it keeps the medication

- **In-vitro dissolution studies of Tablets:**

The USP Dissolving Evaluation Instrument II (Paddle type) has been used to evaluate the floating tablet release rate. The dissolution test was conducted at the

floating in the stomach, resulting in a significantly enhanced reaction.

- Patient compliance is increased by FDDS by lowering the dosage frequency.
- Treatment for digestive issues, including reflux disease of the stomach.
- Despite the first-pass operation, the decreased plasma concentration prevents the drug's bioavailability.
- Since HBS/FDDS formulations irritate the stomach wall and are acidic, they may be helpful when administering aspirin and other comparable medications.
- Beneficial for medications consumed through the stomach, for example, iron salts andantacids.

Medication delivery to the designated location.

Drawbacks of the Floating Medication Delivery System: [95]

- It is not a good idea to incorporate medication compounds into unsteady systems in the stomach's acidic environment.
- In these systems, food is usually required to extend stomach emptying.
- It is not suitable for drugs with problems with GIT stability or solubility.
- The only drugs deemed appropriate candidates are those with a first-pass effect and high absorption throughout the gastrointestinal tract.
- The dosage form's level of hydration affects its propensity to float. It helps to administer water intermittently to keep these tablets floating.

Utilizing a Floating Drug Distribution System:

- **Increased Bioavailability:**

The bioavailability of riboflavin Controlled Release-Gastro Retentive Dosage Forms is considerably higher when it is administered in place of Non-Gastro

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Retentive Dosage Forms Controlled Release polymeric formulations.

- **Prolonged delivery of drugs:**

Oral CR formulations experienced problems in the GIT, including gastric residence time. HBS systems with a density in bulk of less than one that can floaton stomach contents and stay in the gastrointestinal tract for long periods usually solve these problems.

- **Absorption Enhancement:**

Drugs with poor bioavailability from site-specific bioavailability from the upper part of the gastrointestinal tract may be developed into floating drug delivery systems by increasing their absorption.

- **Site-specific drug delivery systems:**

The medication is delivered to the stomach gradually and under control, which lowers the drug's systemic exposure and produces the right local therapeutic rates. Reduced dosing frequency can result from a site-driven drug delivery system's extended gastric availability. Comparable tofurosemide and riboflavin.

A reduction in fluctuations in drug concentration:

When CR-GRDF is administered, In contrast to other immediate-release dosage forms, continuous drug input produces blood drug concentrations within a more constrained range.

Reduced adverse reactions in the colon:

In HBS, Medication kept in the stomach minimizes the quantity that enters the colon. This prevents the colon from experiencing unwanted drug activity.

List of medications of single and multiple unit formsprepared as Floating Drug Delivery System:

Types ofdosage forms	**Medications prepared in floating drug delivery system unit forms, both multiple and single unit forms**
Tablets	The following medications include acetaminophen, Amoxicillin trihydrate, Ampicillin, Captopril, Chlorpheniramine maleate, Cinnarizine, Ciprofloxacin, Diltiazem, Fluorouracil, Furosemide, Isosorbide dinitrate, Isosorbide mononitrate, Nimodipine, Piretanide, Prednisolone, Riboflavin 5 Phosphate, Sotalol, Theophylline, Verapamil HCl,
Capsules	Benserazide, Chlordiazepoxide HCl,Diazepam, Furosemide, Misoprostol, Nicardipine, Propranolol,Urodeoxycholic acid,
Granules	Diclofenac sodium, Indomethacin, Prednisolone
Films	Cinnarizine
Microspheres	Aspirin, Griseofulvin, Ibuprofen,Terfenadine, Tranilast, Verapamil

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Conclusion:

A real project is developing a stomach-specific drug delivery system with an efficient gastro-retentive dosage form. The length of time that a dosage form is retained in the stomach increases the amount of time that a drug is absorbed in the gastrointestinal tract, which is a highly variable process. FDDS seems to be a good method for stomach retention. Consequently, A number of techniques were used to achieve the intended level of gastro retention, but the floating drug delivery system proved to be the most effective. These systems make it possible for medications absorbed from the upper portion of the stomach to be better absorbed, improving the bioavailability and regulated delivery of a variety of medications with innovative and essential therapeutic options. As a result, the treatment is more beneficially efficient and requires fewer doses. Such a system is more dependable due to its superior drug release and stability when compared in comparison to other conventional dosage form. The absorption of drugs in the gastrointestinal tract (GIT) is a very variable system, and gastrointestinal (GI) retention of the medication's dosage form prolongs the period of drug absorption. One technique to guarantee stomach retention is the floating drug delivery system. Many businesses are focusing on bringing this strategy to market, despite the fact that a number of issues need to be resolved in order to achieve prolonged GI retention. The vast array of industrial goods and patents in this field attest to this.

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