WORLD JOURNAL OF PHARMACY AND PHARMACEUTICAL SCIENCES
SJIF Impact Factor 7.421
Volume 8, Issue 1, 629-650 Review Article ISSN 2278 – 4357

FLOATING DRUG DELIVERY SYSTEMS: A NOVEL APPROACH

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Article Received on
12 Nov. 2018,

Revised on 03 Dec. 2018,
Accepted on 23 Dec. 2018,

DOI: 10.20959/wjpps20191-12994

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ABSTRACT

Oral route is widely acceptable and invulnerable route for administration of drugs, but there are also so many problems and challenges in safe delivery of medicament. The gastric emptying time and the variation in PH in different segments of gastrointestinal tract (GIT) are the major challenge task for the development of oral controlled release drug delivery system. Various attempt have been made to enhance the residence time of the dosage form within the stomach. Floating drug delivery systems (FDDS) improves the drug bioavailability and patient compliance by increasing the gastric residence time and controlling the drug release. Floating systems or dynamically controlled systems are low density systems that have sufficiently buoyancy to float over the gastric contents and remain buoyant in the stomach without affecting the gastric emptying rate for a prolonged period of time. This result in an increased gastric retention time and a better control of the fluctuations in plasma drug concentration. The goal of any drug delivery system is o provide a therapeutic mount of drug to proper site in the body to achieve immediately and then maintain a desired drug concentration. The favored point of Floating drug delivery systems over the conventional drug delivery system are reduced frequency of dosing, reduced counter activity of the body, minimized adverse activity at the colon and many moves. The purpose of writing this review on floating drug delivery systems (FDDS) was to focus on the principle mechanism of floatation to achieve gastric retention. The recent developments of FDDS including the physiological and formulation variables affecting gastric retention, approach to design single unit and multiple unit floating systems, their classification, formulation aspects, applications and evaluation are covered in detail.

KEYWORDS: Floating Drug Delivery System, Gastric Residence Time, Evaluation, Application of FDDS.

INTRODUCTION

Floating drug delivery system is also known as Hydrodynamically balanced system (HBS).[1] Oral route for drug delivery is the most desirable and preferred route for achieving both systemic and local therapeutic effects. To decrease drug degradation and loss, to prevent harmful side-effects and to enhance drug bioavailability and the fraction of the drug accumulated in the required zone, various drug delivery, and drug targeting systems are currently under development.[2] Floating systems or dynamically controlled systems are low-density systems that have sufficiently buoyancy to float over the gastric contents and remain buoyant in the stomach without affecting the gastric emptying rate for a prolonged period of time. This results in an increased gastric retention time and better control of the fluctuations in plasma drug concentration.[3] Floating drug delivery systems improves the drug bioavailability and enhances patient compliance by increasing the gastric residence time and controlling the drug release. This not only extend gastric residence time but also does so in an area of the Gastrointestinal tract that would enlarge drug reaching its absorption site in solution and as a result, ready for absorption.[4] The basic principle mechanism is that the system is floating on the gastric content the drug is released slowly at the desired rate from the system. This results in an increased GRI (Gastric residence time) and the better control of fluctuations in plasma drugs concentration.[5] The floating delivery system was prepared in an effort increase the GRT and control drug release of the system. It will provide us new and important therapeutic option for achieving a prolonged and predictable drug delivery profiles in the gastrointestinal tract.[6] FDDS approach may be use for various potential activesagents with narrow absorption window like sulphonamides, tetracyclines, penicillins, quinolones, cephalorporins, aminoglycosides; which are absorbed from very specific regions of gastrointestinal tract.[7] The physiological problems like short gastric residence time and unpredictable gastric emptying time were overcome with the use of floating dosage forms which provide opportunity for both local and systemic effect.[8] Some of the problematic, critical issues related to the rational development of FDDS include-

- The quantitative sufficiency of floating delivery system in the fasting and fed states.
- The role of buoyancy in enhancing gastro residence time (GRT) of FDDS.
- The correlation between prolonged GRT and sustained release/ Pharmacokinetic characteristics.[9]

Selection Criteria For Drug Candidate For Fdds[10]

- Absorption from upper GIT e.g. Ciprofloxacin
- Drugs having low Pka, which remains unionized in stomach for better absorption.
- Local action as it seen in the treatment of Helicobacter pylori by Amoxicillin.
- Drugs having reduced solubility at higher PH, e.g. Captopril and chordiazepoxide.
- The bioavailability of drugs that get degrade inalkaline PH, canbe increased by formulating gastro-retentive dosage forms,e.g. Doxifluridine (dergrade in small intestine)
- To minimize gastric irritation this may be sudden increase of drug concentrate ion in the stomach, e.g. NSAID.
- Drugs that disturb normal colonic bacteria, e.g., Amoxicillin trihydrate.
- Drugs that act locally in the colon, e.g. Ranitidine HCL.[12]

Drug Candidate Unsuitable For Floating Drug Delivery System[13]

- Drugs that have very limited acid solubility e.g. phenytion etc.
- Drugs the suffer instability in the gastric environment e.g. Erythromycin .
- Drugs intended for selective release in the colon, e.g.–amino salicylic acid and corticosteroid.

Mechanism of Floating System

Different methods are used to enhance the retention time of formulation in stomach. It includes introducing floating dosage forms (gas-generating systems and swelling or expanding systems), mucoadhesive systems, high- density systems, modified shape systems, gastric emptying delaying devices and co administration of gastric-emptying delaying drugs. Floating drug delivery systems (FDDS) have always bulk density less than gastric fluids and so remain buoyant in the stomach without affecting the gastric emptying rate for a prolonged period of time. The system is floating on the gastric content, the drug is released slowly at the desired rate from the system. [14] After release of drug, the residual system is emptied from the stomach. This result in an increased GRT and a better control of the fluctuation in plasma drug concentration. [15] However, besides a minimal gastric content needed to allow the proper achievement of the buoyancy retention principal, a minimal level of floating force (F) is also required to keep the dosage form reliably buoyant on the surface of the meal. To measure the floating force Kinetics, a novel apparatus for determination of resultant weight has been reported in the literature. The apparatus operates by measuring continuously the force equivalent to F (as a function of time) that is required to maintain the submerged object.

The object floats better if F is on the higher positive side. This apparatus help in optimizing FDDS with respect to stability and durability of floating forces produced in order to prevent the drawbacks of unforeseeable intragastric buoyancy capability variations [16].

$$F = F(\text{buoyancy}) - F(\text{gravity})$$

$$= (Df - Ds)\, gv$$

Where,

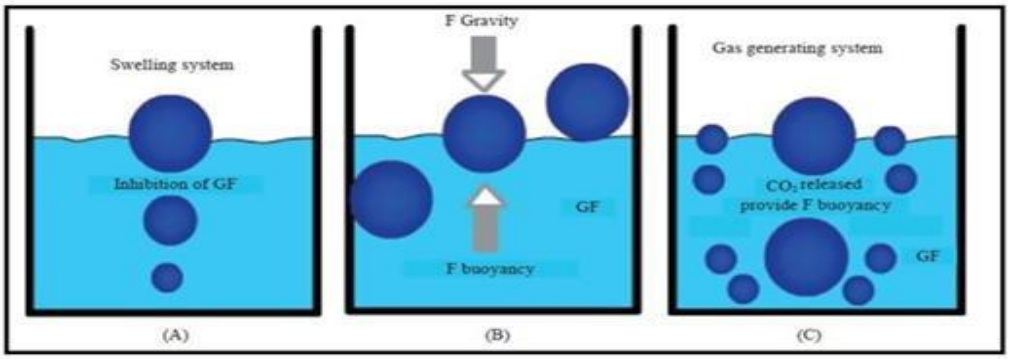
F = total vertical force

Df = Fluid density

Ds = Object density

V = Volume and

g = acceleration due to gravity



Diag 01: Mechanism of Floating Drug Delivery System.

Needs of Fdds[17]

Oral formulations produce low bioavailability problems because of their fast gastric transition from the stomach, specially in case of drugs that are less soluble at an alkaline pH of the intestine. Also the drugs that show their local action in the stomach get their quickly emptied and do not get enough residence time in the stomach. Then, frequency of dose administration in such condition is increased. To avoid such problems floating drug delivery systems has been developed.

Advantages of Fdds

Floating dosage systems form important technological durg delivery systems with gastric retentive behavior and offer several advantages in drug delivery. These advantages include:-

1) Ease of administration with higher patient compliance.[18]
2) Floating dosage forms such as tablet or Capsules will remains in the solution for prolonged time even at the alkaline pH of the intestine.

3) Advantageous for the absorbed through the stomach e.g. Antacids.
4) Acidic substance like aspirin causes irritation on the stomach wall when come in contact with it hence; HBS/ FDDS formulation may be useful for the administration of aspirin and other similar drugs.
5) Treatment of gastrointestinal disorders such as gastroesophagealreflux.
6) FDDS dosage forms are advantageous in case of vigorous intestinal movement and in diarrhoea to keep the drug in floating condition in stomach to get a relatively better response.
7) Improved drug absorption, because of increased GRT and more time spent by the dosage form at its absorption site.
8) FDDS are advantageous for drugs meant for local action in the stomach, e.g. Antacids.
9) Site- specific drug delivery.[19]

Disadvantages

1) FDDS is not suitable for those drugs which have solubility problem in GIT. E.g. Phenytoin
2) Some drugs cause gastric mucosa irritation when delivered by this system.
3) The drugs which are significantly absorbed in the stomach are only best candidate for this system.[20]
4) FDDS require high fluid level in stomach to float and work effectively.
5) Drugs that absorb selectively in colon e.g. Corticosteroid
6) Unsuitable for drugs that are unstable in acidic environment. E.g Erythromycin[21]
7) Requires the presence of to delay gastric emptying.
8) Drugs, which undergo significant first pass metabolism, may not be desirable candidates for FDDS since the slow gastric emptying.[22]

Limitation

1) The major limitation of floating system is the requirement of sufficient high level fluids in the stomach for the drug delivery to float. But this limitation can be overcome by coating the tablet with bioadhesive polymers that easily adhere to the mucosal lining of the stomach.
2) The dosage form should be administrated with a minimum of glass full of water. (200-250 ml).[23]

3) The retention time in the stomach depends upon the digestive state. Hence, FDDS should be administered after the meal.
4) Drugs like Nifedipine, which undergoes significant first pass metabolism, is not a desirable candidate for FDDS since the slow gastric emptying may lead to the reduced systemic bioavailability.
5) The retentions of in the stomach depend upon the subject being position upright.[24]

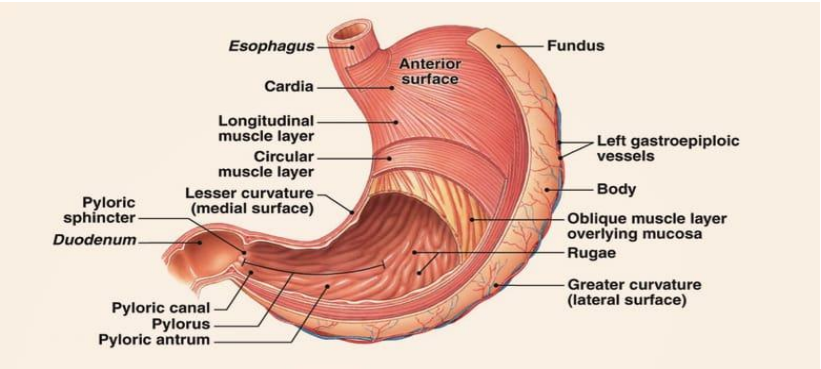
Basic Anatomy And Physiology of The Stomach

The Digestive system consists of a muscular tube, the digestive tract, also called the gastrointestinal tract (GI) or alimentary canal, and various accessory organs. The oral cavity (mouth), Pharynx, esophagus, stomach, small intestine and large intestine, make up the digestive tract. Accessory digestive organs include the teeth, tongue and various glandular organs, such as the Salivary gland, liver and Pancreas, which secrete their products into ducts emptying into the digestive tract.[25]

Anatomy of the stomach

The stomach has the shape of an expanded J. The shape and size of the stomach are extremely variable from individual to individual and even from one meal to the next. The stomach typically extends between the levels of Vertebrae T_7 and L_3. The stomach has four main regions[26]:

a) The Cardiais the smallest part of the stomach.
b) The Fundus is the portion of the stomach that is superior to the junction between the stomach and the esophagus.
c) The Body act as a reservoir for undigested material.
d) The Antrum is the main site for mixing motions and acts as a pump for gastric emptying by propelling actions.[19]



Diag.02 Stomach.

Physiology of the stomach

The stomach is an expanded section of the digestive system between the oesophagus and small intestine. In the empty state the stomach is contracted and its mucosa and sub mucosa are throw up into folds called rugae. There are 4 major types of secretory epithelial cell that covers the stomach and extends into gastric pits and glands.

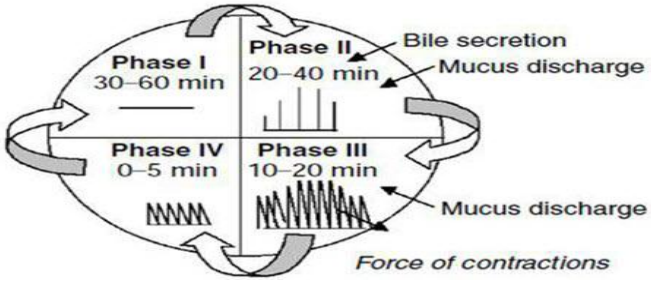
- Mucous cells – secrete alkaline mucus
- Pariental cells – secerete HCL
- Chief cells – secerete pepsin
- G cells – secerete hormone gastrin[26]

Gastric motility and gastric empty rate

Two distinct patterns of gastrointestinal motility and secretion exist to the fasted and fed state. During the fasting state an inter-digestive series on electrical events take place, which cycle both through stomach intestine every 2 to 3 hours. This is called the inter-digestive myloelectric cycle or migrating myloelectric cycle (MMC) which is further divided into following 4 phases[27]

1- **Phase I –** It is a basic phase, remain 30-60 minutes,it lacks any secretory activity and contractile motion.
2- **Phrase II –** It is also known as pre-brust phase, intermittent contractions occur and it last for 20-40 minutes
3- **Phase III –** It is known as brust phase, remain for 10-20 minute. It includes intense and regular contractions for short time.
4- **Phase IV –** It remain for 10-20 minute. It includes intense and regular contractions for short time.

After ingestion of the meals, the pattern of contraction changes from fasted to feed state. These contractions result in reducing the size of food paricles to less than 1mm.[28]



Diag.03: Phases of gastric motility and gastric empty rate

APPROACHES TO DESIGN FLOATING DOSAGE FORMS

1) Single-unit dosage forms

In **low density approach**, the globular shells with density lower than that of gastric fluid can be used as carrier for drug for making single-unit floating dosage form. These shells are then further coated with a mixture of drug polymer. The product floats on the gastric fluid and gradually release the drug for a long period of time.

In **Fluid-Filled floating chamber** type os dosage forms, a gas-filled flotation chamber is incorporated into a micoporous components that covers the drug reservoir. This device should be of swellable size. Device remains floats, within the stomach for a long period of time and slowly release the drug.

Hydrodynamically balanced systems (HBS) enhance the absorption because they are designed such that they stay in GIT sor prolong time. These dosage forms much have a bulk density of less than 1. Drugs which have a better solubility in acidic environment and site specific absorption in the upper part of GIT are suitable candidates for such systems.[2]

Single unit dosage forms are easier to develop but suffer from risk of losing their effects too early due to their all or none emptying from the stomach and, thus they may cause high variability in bioavailability and local irritation due to large amount of drug delivered at a particular site of the gastrointinal tract.[29]

2) Multiple-unit Dosage Forms

The aim of designing multiple-unit dosage form is to develop a reliable formulation that has all the advantages of a single-unit form and also is devoid of any of the above mentioned disadvantages of a single-unit formulations. In pursuit of this endeavor many multiple-unit floatable dosage form have been designed like Microsphere, carbon dioxide-generating multiple-unit oral formulations etc.[30]

Factors Affecting Grt of Fdds

Diag.04: Factor affecting GRT of FDDS.

A) Formulation Factor

i. **Size of tablets:-** Dosage form having diameter of more than 7.5mm have more gastric residence time than that of 9.9mm diameter dosage form.[31]

ii. **Shapes of dosage form:-** The shape of the dosage form is one the factors that affects its gastric residence time. Six shapes (ring tetrahedron, Cloverleaf, string, pellet and disk) were screened in vivo for their gastric retention potential.[19]

iii. **Single or multiple unit formulation:-** Multiple unit formulation show a more predictable release profile and insignificant impairing of performance due to failure of units, allow co-administration of units with different release profiles or containing incompatible substances and permit a larger margin of safety against dosage form failure compared with single unit dosage forms.[32]

iv. **Density:-** The density of a dosage form affects the retention of drug in the stomach and determine the location of the gastro retentive system in the stomach. Those with low density tend to float on the gastric fluid surface while high density systems sink to bottom of stomach.[33]

v. **Viscosity of Polymer:** Viscosity of polymer and their interaction greatly affect the drug release and rafting properties. Low viscosity polymers were found to be more suitable candidates because they enhance rafting properties. An increase in polymer viscosity a decrease in the release rate was observed.[34]

B) Idiosyncratic Factor

i) **Gender:-**Mean ambulatory GRT in males (3.4 ± 0.6 hours) is less compared with their age and race matched female counterparts (4.6 ± 1.2 hours), regardless of the weight, height and body surface.[35]

ii) **Age:** Elderly people, especially those over 70, have a significantly longer GRT.[36]

iii) **Posture:-**GRT can vary between supine and upright ambulatory states of the patient.[37]

iv) **Fed or unfed state:-** Under fasting conditions, the GT notility is characterized by periods of strong motor activity or the migrating myoelectric complex (MMC) that coours every 1.2- 2 hours. However, in the fed state, MMC is delayed and GRT is considerable longer.[38]

v) **Frequency of Feed:-** The GRT can increase by over 400 minutes when successive meals are given compared with a single meal due to the low frequency of MMC.

vi) **Nature of Meal:-** Feeding of indigestible polymers or fatty acid salts can change the motility pattern of the stomach to a fed state, thus decreasing the gastric emptying rate and prolonging drug release.[39]

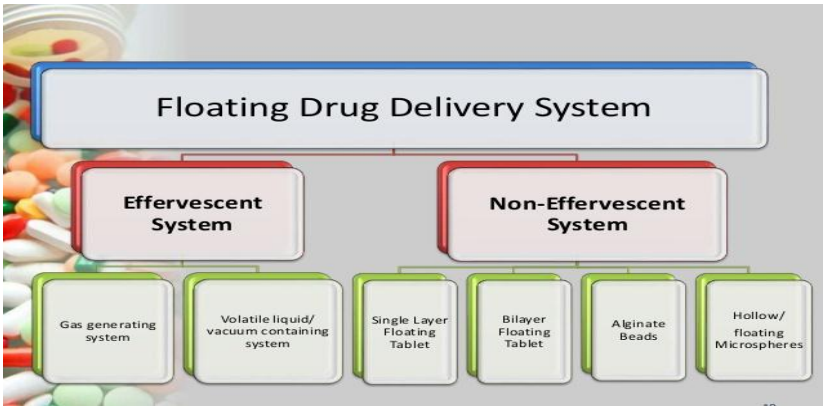
vii) **Caloric content:-** GRT can be increased between 4 to 10 hours with a meal that is high in proteins.[6]

viii) **Emotional State of Subject:-** The influence of emotional factors on gastric motility depending upon whether the emotional experience is of an aggressive or a depressive type.

ix) **Exercise:-** Vigorous physical activity retards gastric emptying.

x) **Disease State:-** Diseases like gastroenteritis gastric ulcer, pyloric stenosis, diabetes and hypothyroidism retard gastric emptying. Duodenal ulcer and hyperthyroidism promote gastric emptying rate.[40]

Classification of Fdds



Diag. 05: Classification of FDDS.

Based on the mechanism of buoyancy two distinctly different technologies Effervescent Floating Drug Delivery system and Non- Effervescent Floating Drug Delivery System has been utilized in the development of FDDS.

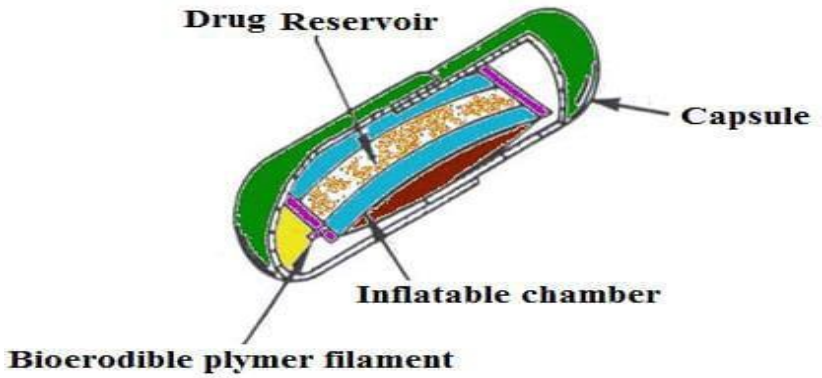
A) Effervescent Systems

Effervescent system involves the use of gas generating agents, Carbonates (Sodium Bicarbonate) and other organic acid (Citric acid and tartaric acid) present in the formulation to produce carbon dioxide (CO_2) gas, thus reducing the density of the system and making it float on the gastric fluid. An alternative is the incorporation of matrix containing portion of liquid, which produce gas that evaporate at body temperature.[41] These effervescent systems further classified into two types.

i) Volatile Liquid Containing systems

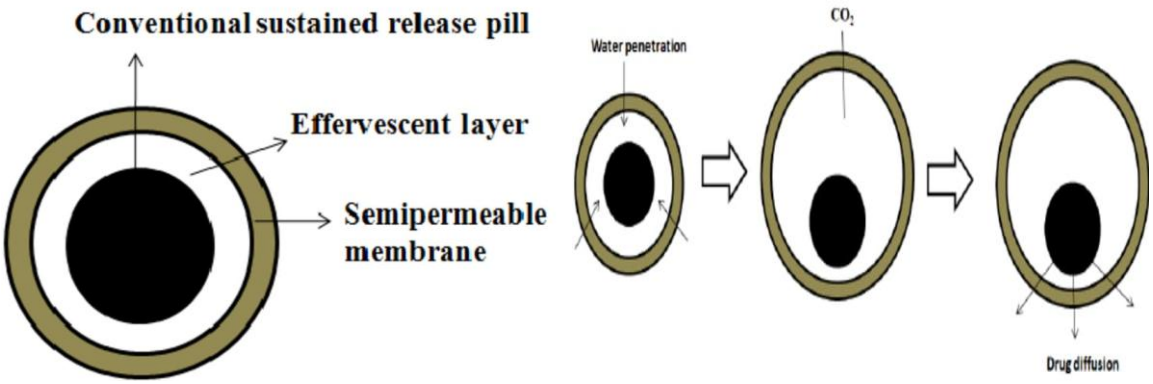
ii) Gas- generating System

i) **Volatile Liquid Containing Systems:** These have an inflatable Chamber which contains liquid example ether, Cyclopentane that gasifies at body temperature to cause the inflation of the Chamber in the stomach. These systems are osmatically controlled floating system containing hollow deformable unit. There are two chambers in the system first contains the drug and the second chamber contains the volatile liquid.[42]



Diag. 06: Volatile Liquid Containing System.

ii) Gas–generating system: These buoyant delivery systems employ effervescent reactions between carbonate/ bicarbonate Salts and Citric/ tartaric acid to liberate CO_2 ,which gets entrapped in the jellified hydro colloidal layer of the systems thus decreasing its specific gravity and making it to float over chyme.[43]



Diag. 07: Gas Generating System.

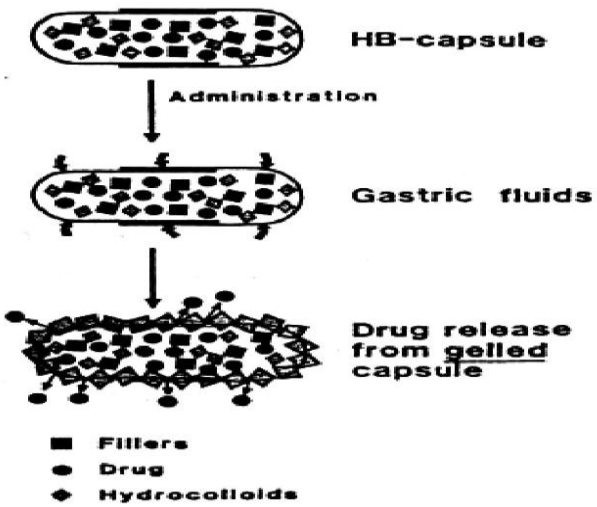
B) Non – Effervescent systems

Non-Effervescent FDDS are normally prepared from gel- forming or highly sellable cellulose type hydrocolloids, polysaccharides or matrix forming polymers like carbopol, HPMC,

Sodium alginate, Chitsan etc.[44] These systems can be further divided into following sub types.

i) Hydrodynamically Balanced System (HBS)
ii) Micro porous compartment system
iii) Hollow Microsphere
iv) Alginate Beads

i) Hydrodynamically Balanced System (HBS) or Colloidal Gel Barrier System: Hydrodynamically Balanced System contains Drugs with gel forming hydrocolloids meant to remain buoyant on the stomach context. These are simple unit dosage form, containing one or more gel forming hydrophilic polymers. The polymer is mixed with drugs and usually administered in hydrodynamically balanced system capsule which get dissolved when came in contact with gastric fluids; the hydrocolloids in the system hydrate and form a colloids gel barrier around its surface. This gel barrier controls the rate of fluid penetration into the device and consequent release of the drug.[45]

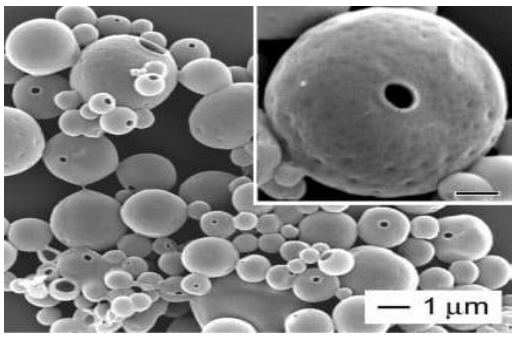


Diag. 08: HBS.

ii) Micro porous Compartment Systems

Micro porous compartment system is based on the encapsulation of a drug reservoir inside a micro porous compartment with pores along its top and bottom walls. The Peripheral wall of the drug reservoir compartment is completely sealed to prevent any direct contact of gastric surface with the undissolved drug. In the stomach, the floatation chamber containing entrapped air causes the delivery system to float over the chyme. Gastric fluid enters through the aperture, dissolves the gastric fluid to an extent that it prevents their exist from the drug and carrier the dissolved drug for continuous transport across the intestine for absorption.[46]

iii) Hollow Microsphere: Hollow microsphere are one of the most promising buoyant systems, as they have various advantages of multiple unit systems as well as better floating properties, because of central hollow space inside. Buoyancy and drug release are dependent on quantity of polymers plasticizer- polymer ratio and the solvent used. Hollow microsphere are prepared by simple solvent evaporation, solvent diffusion and evaporation.[47]



Diag. 09: Hollow Microsphere.

iv) Alginate Beads:- Freeze dried calcium alginates have been used to develop multi- unit floating dosage forms. By dropping sodium alginate solution into aqueous solution of $CaCl_2$(Calcium Chloride) spherical beads of about 2.5mm diameter can be prepared. These beads are separated and air dried. This result in the formulation of aporous system which remains buoyant in the stomach.[48]

Methods of Preparation[49]

1) **Methodology for single layer floating tablets:** Basically single layer floating tablets are prepared by compression methods. For this normally three basic compression methods are used. They are as follows-

- Direct Compression
- Dry Granulation
- Wet Granulation

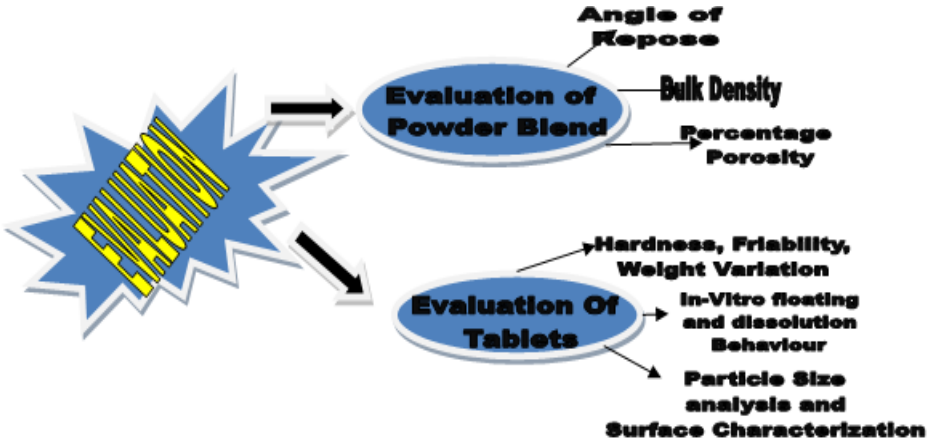
2) **Methodology for Bilayer Floating tablets:-** Bilayer floating tablets are prepared by following method.

- Oros Push Pull technology
- L- Oros Tm Technology
- DUROS Technology
- Geminex Technology

- RoTab Bilayer

EVALUATION OF FLOATING DRUG DELIVERY SYSTEM

The Evaluation parameters for Floating Drug Delivery System (FDDS) are –

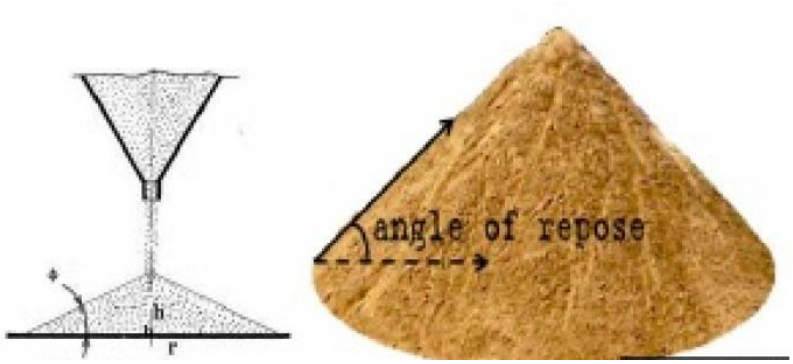


Diag. 10: Evaluation of FDDS.

1) Evaluation of Powder Blend (Pre- Compression Parameters)

a) **Angle of Repose:-**Angle of repose is defined as the maximum angle possible between the surface of the pile of powder and the horizontal plane. Lower the angle of repose, better the flow properties. The angle of repose is calculated by measuring the height of the pile and the radius of the base.[50]

$$\text{Tan } \Theta = h/r$$



Diag.11: Angle of Repose.

b) Bulk Density:-Bulk density present the total density of the material. It includes the true volume of interparticle space and interparticle pores.

$$\textbf{Bulk density} = \frac{Weight\ of\ the\ powder}{Bulk\ volume\ of\ powder}$$

Trapping of powder allows the particles to shift and remove the voids to minimum volume. The volume occupied by the powder in this condition represents the bulk volume.[51]

c) **Percentage Porosity:-**Whether the powder is porous or nonporous, the total porosity expression for the calculation remains the same. Porosity provides information about hardness, disintegration, total porosity etc.[52]

$$\% \text{ Porosity} = \frac{Void\ Volume}{Bulk\ Volume} \times 100$$

2) Evaluation of Floating Tablets (Post Compression Parameters)

A) Hardness:-Hardness indicates the ability of a tablet to withstand mechanical shocks while handling. The hardness of tablets was determined using Monsanto hardness tester. The tablets were randomly picked and hardness of tablets was determined.[53]

B) Friability Test:-The friability of the tablets was determined by using Roche Freabilator. Ten tablets were initially weighed and transfer into friabilator.Thefriabilator was operated at 25 rpm for 4 minutes. The tablets were weighed again. % Friability of tablets less than 1% was considered acceptable.

C) Weight Variation Test:- Ten tablets were selected randomly from each batch and weighed individually to check for weight Variation. A little variation was allowed in the weight of a tablet. The following percentage deviation in weight variation was allowed.[54]

Average wt of a tablet	% deviation
130mg or less	10 %
>130 mg and<324 mg	7.5%
324 mg or above	5%

D) Buoyancy Capabilities of FDDS: The floating behavior is evaluated with resultant weight measurements. The experiment is carried out in two different media, deionised water and simulated meal. The results showed that higher molecular weight polymers with slower rate of hydration had enhanced floating behavior and it was observed more in simulated meal medium compared to deionised water.[55]

E) Floating Time and Dissolution: Floating time measurement is determined by using USP dissolution apparatus containing 900 ml of 0.1 mole lit^{-1}HCl as the dissolution medium at 37^{o} C temperature. The time taken by the dosage form to float is termed as the Floating lag time. Dissolution test are performed by using the dissolution apparatus.[56]

F) Drug loading, Drug Entrapment Efficiency, Particle size Analysis, Surface Characterization: Drug loading is assessed by crushing an accurately weighed sample in

a mortor and adding it to a appropriate dissolution medium which is then centrifused, filtered and analyzed by a variety of analytical methods like spectrophotometry. The percentage drug loading is calculated by dividing the amount of drugs in the sample by the weight of total drugs.

The particle size and size distribution of drug are determined in the dry state by optical microscopy.

The surface characterization is carried out by scanning electron microscope (SEM).[57]

G) Drug Release: Dissolution tests are performed using the dissolution apparatus, samples are withdrawn periodically from the dissolution medium with replacement and then analyzed for their drug content after an appropriate dilution.[58]

H)Swelling Study:-The Swelling behavior of a dosage form was measured by studying its weight gain or water uptake. The dimensional changes could be measured in terms of the increase in tablet diameter and/ or thickness over time. Water uptake was measured in terms of percentage weighing gain.[10]

$$\mathbf{WV = (W1 - W0) / W0 \times 100}$$

Where,

Wt = weight of dosage form at time t

W0 = initial weight of dosage form

I) Yield of Drugs:-The prepared drug with a particular size range are collected and weighted.[59]

$$\textbf{\% Yield} = \frac{\textit{Actual Wtt of Product}}{\textit{Total Wtt of excipient and drug}} \textbf{ x 100}$$

J) Radiology:-X- ray is widely used for examination of internal body systems. BarriumSulphate is widely used Radio opaque marker. So BarriumSulphate is incorporated inside dosage form and X- ray images are taken at various intervals to view GR. [60]

K) Pharmacokinetics studies:-Pharmacokinetic studies include AUC (Area under curve), C_{max} and time to reach maximum plasma concentration (T_{max}) were estimated using a computer, Statistical analyses were performed using a student t test with P, 0.05 as the minimal level of significance.[36]

Application of Fdds[61]

Floating drug delivery offered several applications for drugs having poor bioavailability because of the narrow absorption window in the upper part of the gastrointestinal tract. It

retains the dosage form at the site of absorption and thus enhances the bioavailability. These are-

- Site Specific drug delivery
- Sustained drug delivery
- Absorption Enhancement
- Enhanced bioavailability
- Enhanced first- pass biotransformation
- Sustained drug delivery reduce frequency of dosing.
- Targeted therapy for local ailments in the upper GIT.
- Reduced fluctuations of drug concentration

FUTURE POTENTIAL

- Floating dosage form offers various future potential as evident from several recent publications. The reduced fluctuations in the plasma level of drugs results from delayed gastric emptying.
- Drugs with poor bioavailability due to their limited absorption to the upper GIT can be delivered efficiently thereby maximizing their absorption and improving their absolute bioavailability.
- Buoyant delivery system considered as a beneficial strategy for the treatment of gastric and duodenal cancers.
- The floating concept can also be utilized in the development of various Anti-reflux formulations.
- Developing a controlled release system for the drugs, which are potential to treat the parkinson's disease.
- To explore the eradication of Helicobacter pylon by using the narrow spectrum antibodies.

CONCLUSION

The Floating drug delivery system was prepared in an effort increase the gastric retention time (GRT) of the dosage form and to control drug release. One of the most feasible approaches for achieving a prolonged and predictable drug delivery profiles in the GIT is to control the gastric residence time, using gastro retentive dosage forms that will provide us with new and important therapeutic options. Floating matrix tablets are designed to prolong the gastric residence time after oral administration, at a particular site and controlling plasma

level as well as improving bioavailability. Although there are number of difficulties to be worked out to achieve prolonged gastric retention a large number of companies are focusing toward commercializing this technique.

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