Review Article
AMERICAN JOURNAL OF PHARMACY AND HEALTH RESEARCH
www.ajphr.com
2017, Volume 5, Issue 6
ISSN: 2321–3647(online)

Types and Current Trends In Floating Drug Delivery System

Shyam S Kumar[1*], Nl. Gowrishankar[1], Fasila. VP[1], Shahna Shirin VP[1]
1.Prime College of Pharmacy, Kodumbu PO, Palakkad

ABSTRACT

Floating drug delivery system is a recent advancement in pharmaceutical technology which has also several advantages over the conventional drug delivery systems. Those advantages of floating system can be used in the treatment of world's most affective diseases like cardiovascular diseases. Cardiovascular diseases are group of diseases which are many of the time fetal for the patients due to problems associated with the oral conventional tablets. These problems can be overcome by this delivery system. With an increasing understanding of polymer behavior and the role of the biological factors, it is suggested that future research work on the way of floating drug delivery system should be aimed to control accurately the drug input rate into the gastrointestinal tract for the optimization of the pharmacokinetic and toxicological profiles of cardiovascular agents. This review gives an overview of cardiovascular disease, floating drug delivery system & role of floating drug delivery system in treatment of heart patient.

Keywords: FDDS, Gastro retentive, Enhanced Bioavailability

*Corresponding Author Email: shyamchennath@gmail.com
Received 16 May 2017, Accepted 08 June 2017

Please cite this article as: Kumar SS *et al*., Types and Current Trends In Floating Drug Delivery System . American Journal of Pharmacy & Health Research 2017.

INTRODUCTION

High level of patient compliance has been observed in taking oral dosage forms is due to the ease of administration and handling of these forms .oral sustained drug delivery system is complicated by limited gastric residence time. rapid GI transit can prevent complete drug release in the absorption zone and reduce the efficacy of the administered dose since the majority of drugs are absorbed in stomach or the upper part of small intestine .to overcome these limitations, various approaches have been proposed to increase gastric residence of drug delivery systems in the upper part of the gastrointestinal tract like floating drug dosage systems (FDDS).Gastro retentive systems can remain in the gastric region for several hours and hence can significantly prolong the gastric residence time of drugs that offer numerous advantages ; improves bioavailability, reduces drug waste and improves solubility for drugs that are less soluble in a high PH environment of small intestine[1].

Various approaches have been worked out to improve the retention of oral dosage forms: (1)swelling and expanding systems, (2) alter density dosage forms, (3) low density or floating drug delivery systems;(4) bioadhesive systems (5) high density non-floating drug delivery system ; and (6) modified shaped system [2].They are otherwise classified by :1)floating system,2) expended system,3)bioadhesive system and ,4)high density system.[3]

Floating drug delivery system were first described by Davis in 1968.floating systems or Hydro dynamically controlled systems are low-density systems that have sufficient 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. After release of drug, the residual system is emptied from the stomach. This results in an increased GRT and a better control of the fluctuations in plasma drug concentration. However, besides a minimal gastric content needed to allow the proper achievement of the buoyancy retention principle, a minimal level of floating force(F) is also required to keep the dosage form reliably buoyant on the surface of the meal.

Eg: Nonionic cellulose ethers and most frequently hydroxylpropyl methyl cellulose (HPMC) have been widely utilized for their application in oral sustained drug delivery system. When in contact with aqueous fluid, HPMC hydrates rapidly and forms a gelatinous barrier layer around the tablet. The rate of drug release from HPMC matrix is dependent on various factors such as grade of polymer, solubility of drug, polymer content, particle size of drug and polymer as well as types and amount of filler used in the formulation. The adjustment of polymer concentration,

viscosity grade and addition of different types and levels of excipient to the HPMC matrix can modify the kinetics of drug release[4].

Advantages

1. Floating dosage forms such as tablets or capsules will remains in the solution for prolonged time even at the alkaline PH of the intestine.
2. FDDS are advantageous for drugs meant for local action in the stomach eg: antacids.
3. FDDS dosage forms are advantageous in case of vigorous intestinal movement and in diarrhea to keep the drug in floating condition in stomach to get a relatively better response.
4. Acidic substance like aspirin causes irritation on the stomach wall when come in contact with it hence; HBS/FDDS formulations may be useful for the administration of aspirin and other similar drugs.
5. The FDDS are advantageous for drugs absorbed through the stomach eg : ferrous salts, antacids.

Disadvantages

Floating systems are not feasible for those drugs that have solubility or stability problems in gastric fluids

1. Drugs such as Nifedipine, which is well absorbed along the entire GI tract and which undergo significant first-pass metabolism, may not be suitable candidates for FDDS since the slow gastric emptying may lead to reduced systemic bioavailability. Also there are limitations to the applicability of FDDS for drugs that are irritant to gastric mucosa
2. One of the disadvantages of floating system is that they require a sufficiently high level of fluids in the stomach, so that the drug dosage form float therein and work efficiently
3. These systems also require the presence of food to delay their gastric emptying [5].

Floating Drug Delivery Systems (FDDS)

Based on mechanisms of floating, two different technologies i.e., Effervescent FDDS and Non-effervescent FDDS were attempted to release drug [6]

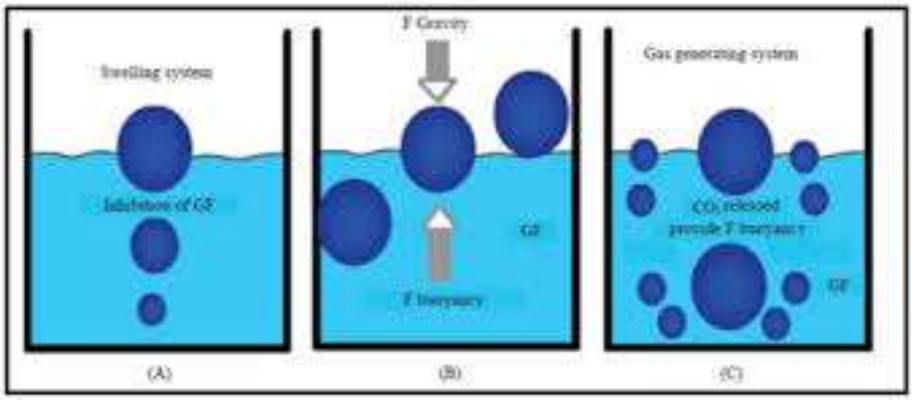


Figure 1: Mechanism of floating system

Factors Affecting Gastric Residence Time of FDDS

a) Formulation factors

Size of tablets

Retention of floating dosage form in stomach depends on the size of tablets. Small tablets are emptied from the stomach during the digestive phase, but large ones are expelled during the house keeping waves.

Floating and non--floating capsules of 3 different sizes having a diameter of 4.8 mm (small units),7.5 mm (medium units),and 9.9 mm (large units),were formulated and analyzed for their different properties. It was found that floating dosage units remained buoyant regardless of their sizes on the gastric contents throughout their residence in the gastrointestinal tract, while the non-floating dosage units sank and remained in the lower part of the stomach. Floating units away from the gastro-duodenal junction were protected from the peristaltic waves during digestive phase while the non-floating forms stayed close to the pylorus and were subjected to propelling and re-propelling waves of the digestive phase.

Density of tablets

Density is the main factor affecting the gastric residence time of dosage form. A buoyant dosage form having a density less than that of the gastric fluids floats, since it is away from the pyloric sphincter, the dosage units is retained in the stomach for a prolonged period. A density of less than 1.0g/ml i.e. less than that of gastric contents has been reported. However, the floating force kinetics of such dosage form has shown that the bulk density of a dosage form is not the most appropriate parameter for describing its buoyancy capabilities.

Shape of tablets

The shape of dosage form is one of 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. The tetrahedron (each leg 2cm long) rings (3.6 cm in diameter) exhibited nearly 100% retention at 24 hr.

Viscosity grade of polymer

Drug release and floating properties of FDDS are greatly affected by viscosity of polymers and their interaction. Low viscosity polymers (e.g, HPMC K100 LV) were found to be beneficial than high viscosity polymers (e.g, HPMC K4M) in improving floating properties . In addition, a decrease in the release rate was observed with an increase in polymer viscosity.

b) Idiosyncratic factors

Gender

Women have slower gastric emptying time than do men. Mean ambulatory GRT in meals (3.4±0.4 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.

Age

Low gastric emptying time is observed in elderly than do in younger subjects. Intra-subjects and inter-subjects variations also are observed in gastric and intestinal transit time. Elderly people, especially those over 70 years have a significantly longer GRT.

Posture

1) Upright position

An upright position protects floating forms against postprandial emptying because the floating form remains above the gastric contents irrespective of its size.

Floating dosage forms show prolonged and more reproducible GRTs while the conventional dosage form sink to the lower part of the distal stomach from where they are expelled through the pylorus by antral peristaltic movements.

2) Supine position

The position offers no reliable protection against early and erratic emptying .In supine subjects large dosage forms (both conventional and floating) experience prolonged retention .The gastric retention of floating forms appear to remain buoyant anywhere between the lesser and greater curvature of the stomach. On moving distally, these units may be swept away by the peristaltic movements that propel the gastric contents towards the pylorus, leading to significant reduction in GRT compared with upright subjects

Concomitant intake of drugs

Drugs such as prokinetics agents (e.g, metoclopramide and cisapride), anti cholinergic (e.g, atropine or propantheline),opiates (e.g, codeine) may affects the performance of FDDS .The co-administration of GI- motility decreasing drugs can increase gastric emptying time.

Feeding regimen

Gastric residence time increase in the presence of food, leading to increased drug dissolution of the dosage form at the most favorable site of absorption .A GRT of 4-10 h has been reported after a meal of fats and proteins.

APPROACHES TO GASTRORETENTION

Several technique are reported in the literature to increase the gastric retention of drugs,

1) High –density systems

These systems, which have a density of ~3g/cm^3 are retained in the rugae of stomach and capable of withstanding its peristaltic movements.

The only major drawback with these systems is that it is technically difficult to manufacture them with a large amount of drug (>50%) and achieve required density of 2.4-2.8g/cm^3.Diluents such as barium sulphate (density =4.9),zinc oxide ,titanium oxide ,and iron powder must be used to manufacture such high-density formulation.

2) Swelling and expanding systems

These systems are also called as “plug type system”, since they exhibit tendency to remain logged in the pyloric sphincters .These polymeric matrices remain in the gastric cavity for several hours even in fed state.

By selection of polymer with the proper molecular weight and swelling properties controlled and sustained drug release can achieved. Upon coming in contact with gastric fluid, the polymer imbibes water and swells .The extensive swelling of these polymers is a result of the presence of the presence of physical-chemical cross links in the hydrophilic of polymer network. These cross link prevents the dissolution of polymer and thus maintain physical integrity of the dosage form a high degree of cross linking retards the swelling ability of the system and maintain its physical integrity for prolonged period. On the other hand, a low degree of cross linking results in extensive swelling followed by the rapid dissolution of polymer.

3) Incorporating delaying excipients

Another delayed gastric emptying approach of interest include feeding of digestible polymers or fatty acid salts that charges the motility pattern of this stomach to a fed stage thereby decreasing the gastric emptying rate and permitting considerable prolongation of the drug release

.Prolongation of GRT of drug delivery system consists of incorporating delaying excipient like trietanolamine myristate in a delivery system.

4) Modified system

System with non disintegrating geometric shape molded from silastic elastomers or extruded from polyethylene blends, which extend the GRT depending on size, shape and flexural modules of drug delivery device.

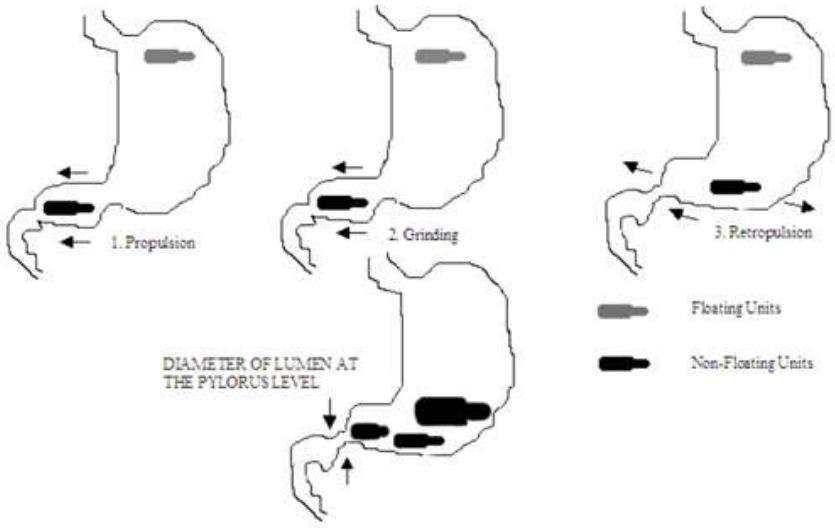
5) Mucoadhesive and bioadhesive systems

Bioadhesive drug delivery systems are used to localize a delivery device within the lumen to enhance the drug absorption in site specific manner. This approach involves the use of bioadhesive polymers, which can adhere to the epithelial surface in the stomach. Some of the most promising excipient that has been used commonly in these systems includes polycarbophil, carbopol, lectins, chitosan, CMC and gliadin, etc.

6) Floating systems

Floating drug delivery systems (FDDS) have a 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. While the system is floating on the gastric contents, the drug is released slowly at the desired rate from the system. After release of drug, the residual system is emptied from the stomach. Floatation of a drug delivery system in the stomach can be achieved by incorporating floating chamber filled with vacuum, air, or inert gas[8].

Approaches to design floating dosage forms



Intra gastric residence positions 1

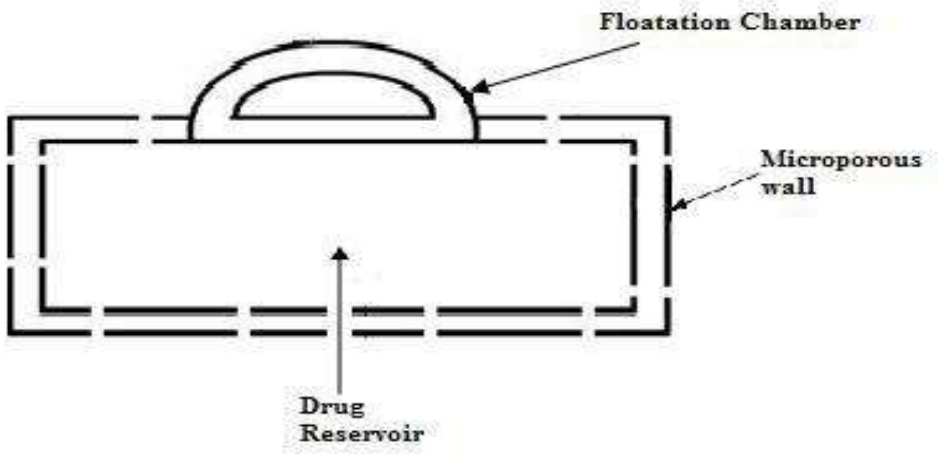
Single unit floating dosage systems

Effervescent systems (gas – generating systems)

These buoyant systems utilized matrices prepared with swellable polymers like HPMC, polysaccharides like chitosan, effervescent components like sodium bicarbonate, citric acid and tartaric acid or chambers containing a liquid that gasifies at body temperature. the optimal stoichiometric ratio of citric acid and sodium bicarbonate for gas generation is reported to be 0.76:1. The common approach for preparing these systems involves resin beads loaded with bicarbonate and coated with ethyl cellulose. The coating, which is insoluble but permeable, allows permeation of water. Thus, carbon dioxide is released, causing the beads to float in the stomach. Excipients used most commonly in these some of the polymers used are hydroxylpropyl cellulose, hydroxylpropyl methylcellulose, Crosspovidone, sodium carboxymethyl cellulose, and ethyl cellulose.

Non –effervescent systems

This type of system, after swallowing, swells unrestrained via imbibition's of gastric fluid to an extent that it prevents their exit from the stomach. These system may be referred to as the 'plug-type system' since they have a tendency to remain lodged near the pyloric sphincter. One of the formulation methods of such dosage forms involves the mixing of drug with a gel, which swells in contact with gastric fluid after oral administration and maintains a relative integrity of shape and a bulk density of less than one within the outer gelatinous barrier. The air trapped by the swollen polymer confers buoyancy to these dosage forms.



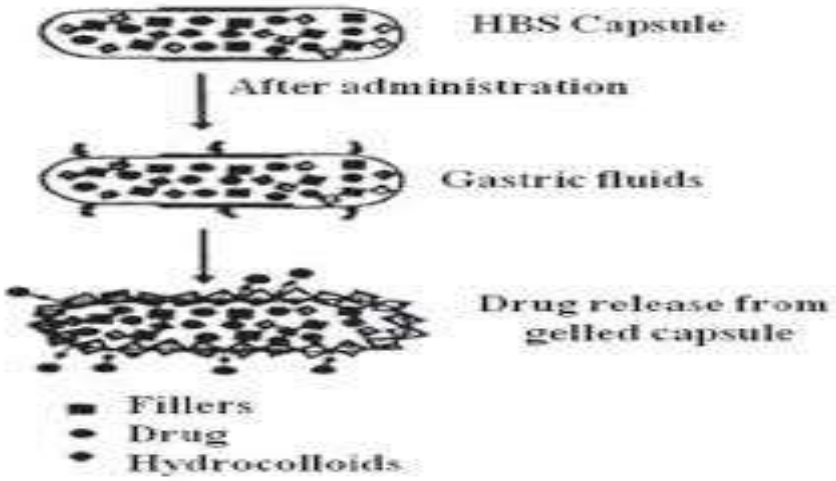
Fluid filled floating chamber type of dosage forms includes incorporation of a gas-filled floatation chamber into a microporous component that houses a drug reservoir. Apertures or openings are present along the top and bottom walls through which the gastrointestinal tract fluid enters to dissolve the drug. The other two walls in contact with the fluid are sealed so that the undissolved drug remains therein. The fluid present could be air, under partial vacuum or any

other suitable gas, liquid, or solid having an appropriate specific gravity and an inert behavior. The device is of swallowable size, remains afloat within the stomach for a prolonged time, and after the complete release the shell disintegrates, passes off to the intestine, and is eliminated.

Multiple unit floating dosage forms

Non –effervescent system

A few works have reported the possibility of developing such system containing indomethacin, using chitosan as the polymeric excipient. A multiple unit HBS containing indomethacin as a model drug prepared by extrusion process is reported. A mixture of drug, chitosan and acetic acid is extruded through a needle, and the extrudate is cut and dried. Chitosan hydrate and floats in the acidic media and the required drug release could be obtained by modifying the drug – polymer ratio.



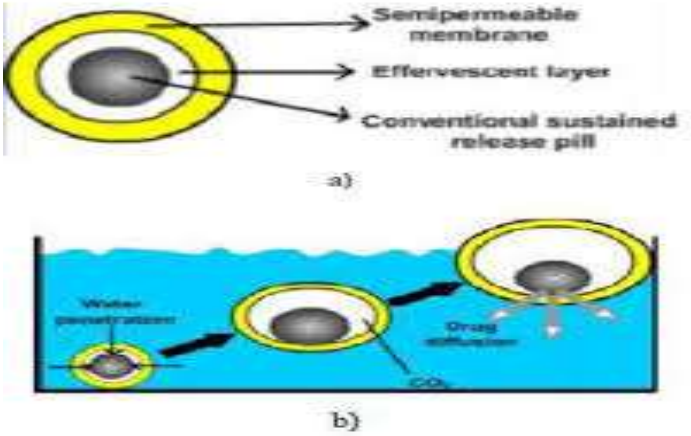
Effervescent systems

Sustained release floating granules containing tetracycline hydrochloride. The granules are a mixture of drug granulates of two stages A and B, of which A contains 60 parts of HPMC, 40 parts of polyacrylic acid and 20 parts of drug and B contains 70 parts of sodium bicarbonate and 30 parts of tartaric acid. 60 parts by weight of granules of stages A and 30 parts by weight of granules of stages B are mixed along with a lubricant and filled into capsule.

Hollow microsphere

Hollow microspheres are considered as one of the most promising buoyant systems, as they possess the unique advantages of multiple unit systems as well as better floating properties, because of central hollow space inside the microsphere. The general technique involved in their preparation includes simple solvent evaporation, and solvent diffusion and evaporation. The drug release and better floating properties mainly depend on the type of polymer, plasticizer and the

solvents employed for the preparation. Polymers such as polycarbonate, Eudragit R S and cellulose acetate were used in the preparation of hollow microspheres, and the drug release can be modulated by optimizing the polymer quantity and the polymer-plasticizer ratio.



Raft forming systems

Raft forming system has received much attention for the delivery of antacids and drug delivery for gastrointestinal infections and disorders. The mechanism involved in the raft formation includes the formation of viscous cohesive gel in contact with gastric fluids, wherein each portion of the liquid swells forming a continuous layer called a raft. This raft floats on gastric fluids because of low bulk density created by the formation of CO2.Usually,the system contain a gel forming agent and alkaline bicarbonates or carbonates responsible for the formation of the CO2 to make the system less dense and float on gastric fluids Jorgen *et al* described an antacid raft forming floating system. The system contain a gel forming agent [e.g. alginic acid],sodium bicarbonate and acid neutralizer, which forms a forming sodium alginate gel[raft]when in contact with gastric fluids. The raft thus formed floats on the gastric fluids and prevents the reflux of the gastric contents [i.e. gastric acid]into the esophagus by acting as a barrier between the stomach and esophagus [7].

Marketed products of FDDS

The last three decades of intensive research work have resulted in the development of five commercial FDDS. Madopar HBS (Prolopa HBS) is a commercially available product used in Europe and other countries, but not available in the US. It contains 100mg levodopa and 25mg benserazide , a peripheral dopa decarboxylase inhibitor. This CR formulation consists of a gelatin capsule that is designed to float on the surface of the gastric fluids. After the gelatin shell dissolves, a mucus body is formed that consist of the active drugs and other substances. The drugs diffuse as successively hydrated boundary layers of the matrix dissipate. Val release is a

second example of a floating capsule, marketed by Hoffmann-LaRoche, that contains 15mg diazepam,; the latter is more soluble at low Ph. Thus, diazepam (pKa=3.4) absorption is more desirable in the stomach, not in the intestine where it is practically insoluble and is poorly absorbed. The HBS system maximizes the dissolution of the drug by prolonging the GRT. Moreover, pharmacokinetic data have demonstrated the blood level equivalence of once per day dosing with the HBS capsule to three times daily dosing from conventional, 5mg Valium tablets.

Floating liquid alginate preparations, e.g., Liquid Gaviscon, are used to suppress gastroesophageal reflux and alleviate the symptoms of "heart burn". The formulation consists of a mixture of alginate, which forms a gel of alginic acid, and a carbonate or bicarbonate component (e.g., sodium bicarbonate),which reacts with gastric acid and evolve co2 bubbles, and floats on the gastric contents as a viscous layer, which has a higher PH than the gastric contents.

Topalkan is a third-generation aluminum –magnesium antacid that involves not only its antacid properties but an even greater degree the availability of alginic acid in its formula. It has antipeptic and protective effects with respect of the mucous membrane of the stomach and esophagus, and provides, together with the magnesium salts, a floating layer of the preparation in the stomach. Almagate Flot Coat is another novel antacid formulation that confers a higher antacid potency together with a prolonged GRT and a safe as well as extended delivery of antacid drug. It is obvious that these newer formulations differ from the standard antacid products, which are either rapidly neutralized to water-soluble ions or sediment to the fundus of the stomach, and are evacuated in to the duodenum by normal peristalsis.[9]

RECENT ADVANCE IN STOMACH SPECIFIC FLOATING DOSAGE FORMS

Mechanism of floating and drug release behavior of poly (vinyl acetate)-based floating tablets with membrane controlled drug delivery .Propranolol Hcl containing tablets with kollidon SR as an excipient for direct compression and different Kollicoat SR 30 D/Kollicoat IR coats varying from 10 to 20 mg polymer/cm^2 SR/IR, 8.5:1.5 coat exhibited the shortest lag times prior to drug release and floating onset ,the fastest increase in and highest maximum values of floating strength .The drug release was delayed efficiently within a time interval of 24 h by showing linear drug release characteristics.

A gastroretentive drug delivery system of DA-6034, a new synthetic flavanoid derivative , for the treatment of gastritis was developed by using effervescent floating matrix system (EFMS).The therapeutic limitations of DA-6034 caused by its low solubility in acidic conditions were overcome by using the EFMS ,which was designed to cause tablets to float in gastric fluid

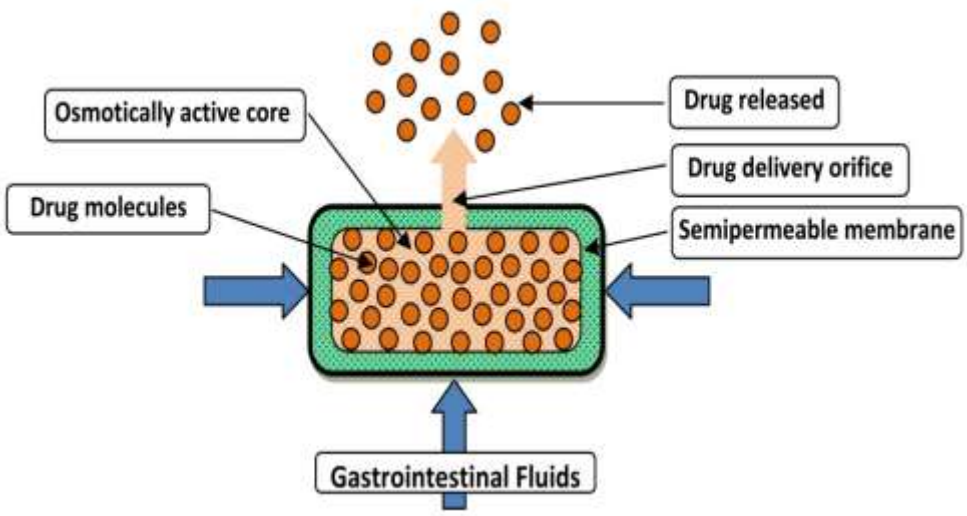
and release the drug continuously .The release of DA-6034 from tablets in acidic media was significantly improved by using EFMS ,which is attributed to the effect of the solubilizers and the alkalizing agent such as sodium bicarbonate used as gas generating agent.DA-6034 EFMS tablets showed enhanced gastro productive effect in gastric ulcer-induced beagle dogs, indicating the therapeutic potential of EFMS tablet for the treatment of gastritis

A floating in situ gelling system of clarithromycin(FIGC)using gellan as gelling polymer and calcium carbonate as floating agent for potentially treating gastric ulcers, associated with helicobacter pylori. Gellan based FIGC was prepared by dissolving varying concentrations of gellan is deionized water to which varying concentrations of drug and sucralfate were dispersed well. The addition of sucralfate to the formulation significantly suppressed the degradation of clarithromycin at low PH.FIGC showed a significant anti-H.pylori effect than that of clarithromycin suspension .The in situ gel formulation with sucralfate cleared H.pylori more effectively than that of formulation without sucralfate. In addition the required amount of clarithromycin for eradication of H.pylori was found to be less from FIGC than from the corresponding clarithromycin suspension. It was concluded that prolonged gastrointestinal residence time and enhanced clarithromycin stability resulting from the floating in situ gel of clarithromycin might contribute better for complete clearance of H.pylori.[7]

NEWER TREND IN FLOATING DRUG DELIVERY

Floating Osmotic Drug Delivery

A floating osmotic drug delivery system employs the principal of osmotic pressure to float on the gastric fluid. Basically these systems comprise of three parts; an osmotic core (containing drug reservoir, osmotic agents, and other excipients), a shape retaining semipermeable membrane; and an outer compression coating consisting of gas generating and gel forming agents. For delivery of drug an orifice is bored through both the outer layers. After administration when this system comes in contact with gastric fluid, initially CO2 is generated due to the presence of a gas forming agent and this generated gas entraps within the bed of swelled gel, thus the system became buoyant due to diminished density Delivery of drug then totally depends upon the osmotic pressure generated inside the osmotic core. First a saturated solution of drug is former due to the flow of fluid through the semipermeable membrane and second expulsion of drug through the orifice due to osmotic pressure develops within the osmotic core. A major advantage of floating osmotic drug delivery systems is that they deliver drug independent to physiological parameters like pH of gastric fluid[37,38].



Floating osmotic drug delivery system

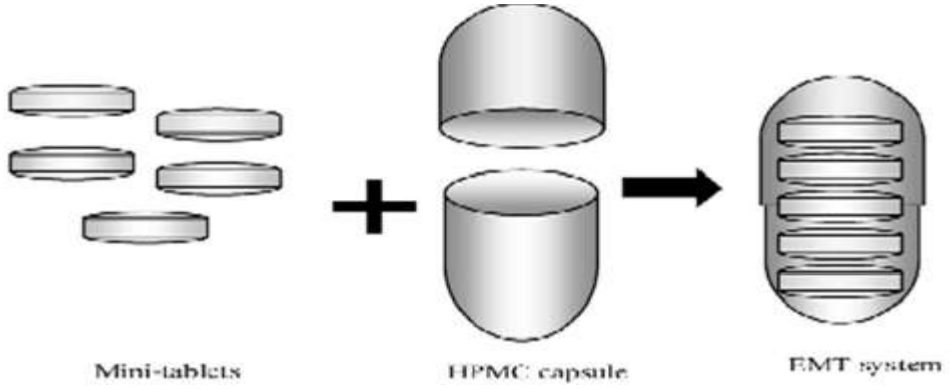
In some cases the reduction in bioavailability is compensated by advantages offered by FDDS, for example a hydrodynamically balanced system of L-dopa provided better control over motor fluctuations in spite of reduced bioavailability of up to 50% to 60% in comparison with standard L-dopa treatment. This could be attributed to reduced fluctuations in plasma drug levels in case of FDDS49,50.

Floating Minitablets

Floating minitablets (MT) of levodopa prepared by melt granulation and subsequent compression. The investigation showed that MT composition and MT diameter had the greatest influence on drug release, which was sustained for more than 8 hrs. The best floating properties were obtained with 3mm MT prepared at low compression forces ranging between 50 and 100 N. It was found that dissolution profiles depend more on the prolonged release ability of Methocel® K15M than on the pH dependent solubility of levodopa51 Scintigraphic and pharmacokinetic studies were conducted on sustained floating minitablets of levodopa on ten healthy fed volunteers. Two concepts of sustained-release floating minitablets – Levo- Form 1 (matrix) and 2 (coated) were evaluated and compared to the marketed product Prolopa®. HBS 125. It was shown that the three formulations offered almost the same mean gastric residence time, which was about 240 mins. Prolopa® HBS 125 and Levo-Form 2presented intragastric disintegration, which can lead to a more pronounced "peak and valley" effect on the plasma concentration–time profile of levodopa. In contrast, the plasma

concentration– time profile of levodopa following the administration of Levo-Form 1 was more evenly distributed. Moreover, Levo-Form 1 provided the lowest variations between men and women in terms of AUC and Cmax values. Finally, when the same amount of inhibitors of

extracerebral dopa decarboxylase – carbidopa and benserazide – had been administrated, the mean AUC, Cmax and Tmax values obtained for benserazide were lower than those obtained for carbidopa53. Novel sustained release dosage form consisting of immediate release mini-tablets (IRMT) and sustained release minitablets (SRMT) contained in a hydroxypropyl methyl cellulose (HPMC) capsule were developed. The IRMT contained pseudoephedrine (PSE), excipients and low substituted hydroxypropyl cellulose (a disintegrant), and the tablets were coated with HPMC, water soluble polymer. IRMT prepared with varying amounts of low substituted hydroxypropyl cellulose all dissolved completely within the first 60 mins, so low substituted hydroxypropyl cellulose content does not greatly influence PSE release. The SRMT contained only PSE and excipients, and were coated with a mixture of HPMC and the water insoluble polymer ethyl cellulose. The PSE release profile for the SRMT could be controlled by varying the thickness of the coat, and the lag time could be controlled by varying the amount of ethyl cellulose present in the polymer coat. PSE was released immediately from encapsulated mini tablet system and release was sustained over an extended period of time: the PSE in the IRMT dissolved within 60 mins, whereas the PSE in the SRMT was released over 8–10 hrs52.



Mini tablet

Floating minitablets of furosemide54 were developed based on gas formation technique. The system consists of core units (solid dispersion of furosemide: povidone and other excipients), coated with two successive layers, one of which is an effervescent (sodium bicarbonate) layer and other one an outer polymeric layer of polymethacrylates. Only the system using Eudragit RL30D and combination of them as polymeric layer could float within acceptable time. The time polymeric layer decreased. The drug release was controlled and linear with the square root of time. By increasing coating level of polymeric layer decreased the drug release. The rapid floating and the controlled release properties were achieved in this present study. The *in vivo*

gastric residence time was examined by radiograms and it was observed that the units remained in the stomach for about 6 hrs.[11]

APPLICATION OF FLOATING DRUG DELIVERY

Systems enhanced bioavailability

The bioavailability of riboflavin CR-GRDF is significantly enhanced in comparison to the administration of non GRDFCR polymeric formulation. There are several different processes, related to absorption and transit of the drug in the gastrointestinal tract, that act absorption. Concomitantly to influence the magnitude of drug

Sustained drug delivery

Oral CR formulations are encountered with problems such as gastric residence time in GIT. These problems can

be overcome with the HBS systems which can remain in the stomach for long periods and have a bulk density<1 as a result of which they can float on the gastric contents. These systems are relatively larger in size and passing from the pyloric opening is prohibited.

Site-specific drug delivery systems

These systems are particularly advantageous for drugs that are specifically absorbed from the stomach or the proximal part of the small intestine .The controlled, slow delivery of drug to the stomach provides that are caused by the drug in blood circulation .In addition, the prolonged gastric availability from a site directed delivery system may also reduce the dosing frequency Eg; Furosimide and riboflavin.

Absorption enhancement

Drugs which are having poor bioavailability because of site specific absorption from the upper part of the GIT are potential candidates to be formulated as floating drug delivery systems ,there by maximizing their absorption.

Minimized adverse activity at colon

Retention of the drug in the HBS systems at the stomach minimize the amount of drug that reaches the colon .Thus, undesirable activities of the drug in colon may be prevented.

Reduced Fluctuations of drug concentration

Continuous input of the drug following CRGRDF administration produces blood drug concentration with in a narrower range compared to the immediate release dosage forms. Thus, fluctuations in drug effects are minimized and concentration dependent adverse effect that are associated with peak concentrations can be prevented.

Sustained drug delivery

Oral CR formulations are encountered with problems such as gastric residence time in GIT. These problems can be overcome with the HBS systems which can remain in the stomach for long periods and have a bulk density <1 as a result of which they can float on the gastric contents. These systems are relatively larger in size and passing from the pyloric opening is prohibited.

Site-specific drug delivery systems

These systems are particularly advantageous for drugs that are specifically absorbed from the stomach or the proximal part of the small intestine .The controlled, slow delivery of drug to the stomach provides that are caused by the drug in blood circulation .In addition, the prolonged gastric availability from a site directed delivery system may also reduce the dosing frequency Eg; Furosimide and riboflavin.

Absorption enhancement

Drugs which are having poor bioavailability because of site specific absorption from the upper part of the GIT are potential candidates to be formulated as floating drug delivery systems, there by maximizing their absorption.

Minimized adverse activity at colon

Retention of the drug in the HBS systems at the stomach minimize the amount of drug that reaches the colon .Thus, undesirable activities of the drug in colon may be prevented.

Reduced Fluctuations of drug concentration

Continuous input of the drug following CRGRDF administration produces blood drug concentration with in a narrower range compared to the immediate release dosage forms. Thus, fluctuations in drug effects are minimized and concentration dependent adverse effect that are associated with peak concentrations can be prevented.

CONCLUSION AND SUMMARY

The currently available polymer- mediated non effervescent and effervescent floating drug delivery system, designed on the basis of delayed gastric emptying and buoyancy Principles, appear to be a very much effective approach in controlled drug delivery. The floating drug delivery system, become an additional advantage for drugs that are absorbed primarily in upper part of GIT. floating drug delivery system play an important role of buoyancy in enhancing gastric retention time of drug and more than that formulation of an ideal dosage form to be given locally to eradicate H. pylori responsible for gastric ulcers worldwide. By understanding the floating and gel forming behaviour of polymers we can look forward to improve the gastric

retention. Similarly, good stability and better drug release than other conventional dosage forms make such system more reliable.

REFERENCE

1. Md. Nazmul Hussain , Md. Abdullah Al Masum , Sharmin Akhter , Florida Sharmin and Md. Selim Reza 2012. Formulation and evaluation of gastro retentive floating tablets of simvastatin using hydrophilic rate retardant., Bangladesh pharmaceutical journal 15(2):119-126
2. Swamy P .V . , Bhosale U. V., Hiremath S.N., Shirsand S.B., and Raju S.A. 2008. Formulation and optimization of gastric floating drug delivery system of atenolol using 3^2 full factorial design., Indian drugs 45(4)
3. Mina Ibrahim Tadros 2009. Controlled-release effervescent floating matrix tablets of ciprofloxacin hydrochloride: development, optimization and in vitro-in vivo evaluation in healthy human volunteers. European journal of pharmaceutics and biopharmaceutics 74 (2010) 332-339
4. V. F. Patel and N. M. Patel,2007.statistical evaluation of influence of viscosity of polymer and types of filler on dipyridamole release from floating matrix tablets., Indian journal of pharmaceutical sciences: 51-57
5. Arunachalam , M. Karthikeyan , Kishore konam , Pottabathula hari Prasad , S. Sethuraman , S, Ashutoshkumar , S. Manidipa 2011.floating drug delivery system: A review., international journal of research in pharmaceutical sciences:76-83
6. N.Arunkumar , c rani and kp mohanraj.2008.formulation and invitro evaluation of oral floating tablets of atorvastatin calcium. Research J. Pharm Tech,1(4):oct-dec.2008.492-495
7. Shiv Shankar Hardenia,Aukit Jain, Ritesh patel, Anu Kaushal. Floating drug delivery system; A review Asian journal of pharmacy and life science vol.1(3),July-sept,2011.284-293
8. Neha Narang 2010.An updated review on: Floating Drug delivery system(FDDS). International Journal Applied Pharmaceutics.1-7
9. Rakesh Pahwa, Shiv Bhagwan. Role of Natural Polymers in the Development of Floating Drug Delivery Systems, Journal of Pharmacy Research 3 (2010) 1312-1318. 48.

10. Brahma N. Singh, Kwon H. Kim 1999.floating drug delivery system: an approach to oral controlled drug delivery via gastric retention. Journal of controlled release 63 (2000) 235-259
11. Sushma Singh ,Kisan Jadhav , Pushpendra Tripathi 2013, various approaches in floating drug delivery ,Inter National Journal of Pharmaceutical and Phytopharmacological research .2013, 2(5):360-371