*Review Article*

# Advancement and development of floating drug delivery: An overview

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**Abstract**

The objective of floating drug delivery system (FDDS) is to attain preferred concentration of the drug in blood or tissue, which is therapeutically efficient and without-toxic for a prolonged time. Various attempts have been made to build up gastroretentive delivery systems like as high density system, swelling, floating system. The current developments of floating drug delivery system with the physiological and formulation variables affecting such as gastric retention, approaches to design single-unit and multiple-unit floating systems and their classification and formulation aspects are covered in detail. This review summarizes all the following parameters such as evaluation, performance and application of floating systems. In order to keep away from this variability, efforts have been made to enhance the retention time of the drug-delivery systems for more than 12 hours. The floating or hydrodynamically controlled drug delivery dosage system are much useful in prolong therapy.

***Keywords*:** Floating drug delivery system, gastrointestinal, gastro retentive system

## Introduction

This is broadly accepted that the volume of G.I.T. drug absorption is associated to contact period with the part of digestive tract covering layer. It means, part of digestive tract movement period is a crucial limitation for dosage form being not completely consumed (Arora et al., 2005). A floating dosage form may remains into the abdomen area for several hours and therefore extremely prolongs the abdomen stay period of drug. It may be use full for proximal part of digestive tract and abdomen for the local drug delivery purpose. The stay time is beneficial to best applicable of given newer product along with therapeutics chance and important for patients. A dosage form which may be used as controlled retention may be obtained by some modification in their shape such as expansion flotation and muco-adhesion. The gastric emptying would be delay by simultaneous administration of active pharmaceutical agent (Kumar et al., 2016).

Researcher has been discussed on floating drug delivery system and evaluation on the *in- vivo* and *in-vitro* patterns and assed the efficiency and applications of this type of formulation. Various current example have been described by the ability of this type of dosage form and problems of it bioavailability (Arora et al., 2005).

## Concept of gastric retention

Various concepts of oral dosage form has been introduced for enhancing the time for abdominal stay along with buoyant systems enlarged and by modified expanded shape system much density systems and other abdomen vacant device (Yadav et al., 2012), which includes Magnetic systems, Super porous-biodegradable hydro gel system and some newer concept are present as:-

(a). Hydros dynamically balance system (HBS) included afloat materials enable to float the device.

(b). An alginate gels is a floating system which have a

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component of carbonate and react with gastric acid by formed bubbles on that place which is enable to float.

(c). The dosage form which are swelling type and after that their swell exit are prevented from stomach via pylorus. This type of dosage form stay in the abdomen for prolong period. Hence these systems are known as "Plug type system". They exhibit the habit to retain introduced into the antrum sphincters. These type formulations are remains into the abdomen for a long time.

(d). A local drug delivery device known as mucoadhesive used for body cavity to enhance the drug absorption technique as a site specific manner. The approach for bio adhesive polymers is used as adhesion to the epithelial surface of the G.I.T. The work of bio adhesive incorporated the generation of electrostatic bonding and hydrogen at the boundary of mucus polymer.

(e).Non-disintegrating geometric shape molded and modified shape system is a drug delivery device which is form silastic elastomeric or exuded form polyethylene blend and remains in the G.I.T. for long period. This is mainly depending on there the content, configuration and flexural modulus.

(f). A dosage form which have high density and incorporated along with coated pellets and their density more than the contents (1.004gm/cm3) of abdomen. This is done by coating them a heavy inert material such as a titanium dioxide, barium sulphate and zinc oxide. High density pellet formulation is depends on assumption of heavy pellets that might stay prolong period in the abdomen, Hence they are bearing in lower part of the pylorus.

(g).Another delayed gastric emptying concept of was incorporated in few feeding of digestible polymer or fatty acid salt which can motility pattern charge. In the fed stage of the abdomen emptying of gastric rate is decreased and allowing drug release prolongation comfortably.

The absorption of active medicament from the G.I.T. tract is a though step and when it was subjected to various variables that causes to uncertainty results in the *in- vitro and in- vivo* performances.

- Non -uniform absorption profiles were acquired by variations in the G.I.T transit time .This factor leads to the imperfect drug discharge. The dosage form had got a small residence in stomach. In the upper tract of the small which have individuals and narrow absorption window hence the absorption of drug especially imperfect.
- All these factors on the absorption sites a minimum quantity of drug is only accepted and the remaining quantity of drug are going for unabsorbed.
- Active pharmacological agent having small half life and eliminated quickly from the blood circulate.
- The targeted therapy of drug is not possible.
- The fluctuation in plasma drug concentration is found in those drugs which have narrow therapeutics index.
- Faster drugs release lead to maximize the counter activity hence drug efficacy is lesser.

For the main focus of the prolongation of the gastric residence time an oral controlled release drug delivery system may lead to developed that controlled the release of floating dosage form. Therefore prolongation of gastric residence time can be obtained by following methodology includes- alginate gel and bio adhesive or mucoadhesive high density system, floating drug delivery system, magnetic system and low density system of raft system etc

**Designing of floating dosage forms**

In the beginning of 1968 the concept of floating drug delivery system was mention in the article that the after swallowing of medicinal pills few of people are feeling chocking and gagging throat and to solve this problem a technique were described by Davis. A warning given by author that the pills which have less thickness than 1g/cm not chock.

**Designing of single and multi-unit dosage form**

For design of Single and multiple unit systems of floating dosage following concept has been used

***For single unit dosage form***

(i) Period of buoyant & ***in-vitro*** drug delivery :- It is determine by using drug dissolution apparatus or USP II apparatus (paddle) in artificial stomach fluids which is without pepsin and pH was 1.2.This apparatus is allow to revolving 50 to 100 rpm at $37^0$C. For the drug contented analysis collection of some of the sample. The duration taken by tablets in floating stay it is seen visually.

(ii) Buoyant period for move slowly:- The tablets taken duration to appear on to the surface of a medium in which dissolve and show in second or minutes.

(iii) In-vitro estimation FDDS:- Conveyance of the formulation in to the g.i.t. and check by using X-ray or gamma scintigraphy. Hardness test, disintegration test, weight variation etc

***Multiplex-unit formulation***

For the purpose of preparing a multiplex formulation develop a faithful dosage form that has benefit for a single unit form and free from any above mentioned demerit of

singleunit dosage form. Many multi-unit buoyant dosage form have been prepare for trailing this goal. Many polymers have been used alike polymathacrylate, albumin, polyalkyl cyanoacrylate, starch and gelatin in formulation of microspheres which have much drug loading ability. Globular polymeric microsphere has been form and additionally mention just as "microbaloons". Microsphere has been inner empty structural property and shows an excellent ex-vivo float capacity. In a new patent article producing of $CO_2$ in multiunit oral dosage form have been mention several property of container that inflated, unfold or extent after administering. From the transition of the pyloric sphincter the formulation are expel if a diameter of approx 12 to 18 mm in there enlarge condition is best (Kumar et al., 2016).

**Categorization of buoyant drug release set up**

Effervescent and non effervescent formulations are classified in floating drug delivery system depending on use.

Various effervescent compounds like citric acid, sodium bicarbonate, tartaric acid, chitoson and swelling polymers which used for designing of grids type system (Prajapati et al., 2015).

Recently a multiple type buoyant had been manufacturing by using of tolerant membrane and bouncy layer is coated on development of sustained release pills. To divert the direct touch between the two agents inside bouncy layer against containing tartaric acid and sodium bicarbonate apart into binary coating. These alternate layer were enclosed by absorption polymer membrane include polyvinyl acetate and fresh trounce. If this system was absorbed and diffuse into bouncy layer through the outer absorption layer adjust in to a buffer solution at $37^0$C. The $CO_2$ was produced by deactivate the reaction in the middle of the two bouncy agents and generating swollen pills (like balloons) with a less thickness than 1.0 g/ml. The dosage form had best buoyant capacity separate of viscosity and pH the medicine (Para-amino benzoic acid) deliver in a sustained manner was found (Figure 1A and B) (Chaturvedi et al., 2013).

Researcher has work out a triple layer asymmetric tablet with a long buoyant capacity in stomach and stay for long period. For example (tetracycline, metronidazole, chlarithromycine) are used in treatment of peptic ulcers as *helicobacter pylori* and this tablets is made by using like poly ethylene oxide (PEO) hydroxyl propyl methyl cellulose (HPMC) excipients as the rate controlling polymeric membrane. For making of this type of drug delivery system was based on the concept of triple- layer asymmetric tablets. Hydroxy propyl methyl cellulose and poly ethylene oxide were the wide ratio for regulating polymeric excipients. Tetracycline and Metronidazole were included into the core layer of the three-membrane matrix for controlled delivery while bismuth salt was incorporated into one of the outer membrane for constant deliver. The bouncy was completed incorporating by a $CO_2$ producing membrane of sodium bicarbonate in (1:2ratio) together with the polymers. The *in-vitro* analysis show that the sustained release of Tetracycline and Metronidazole over 6 to 8 hr could be obtain while the tablet unsinkable (Khan et al., 2010). Researcher formulate unsinkable alginate beads

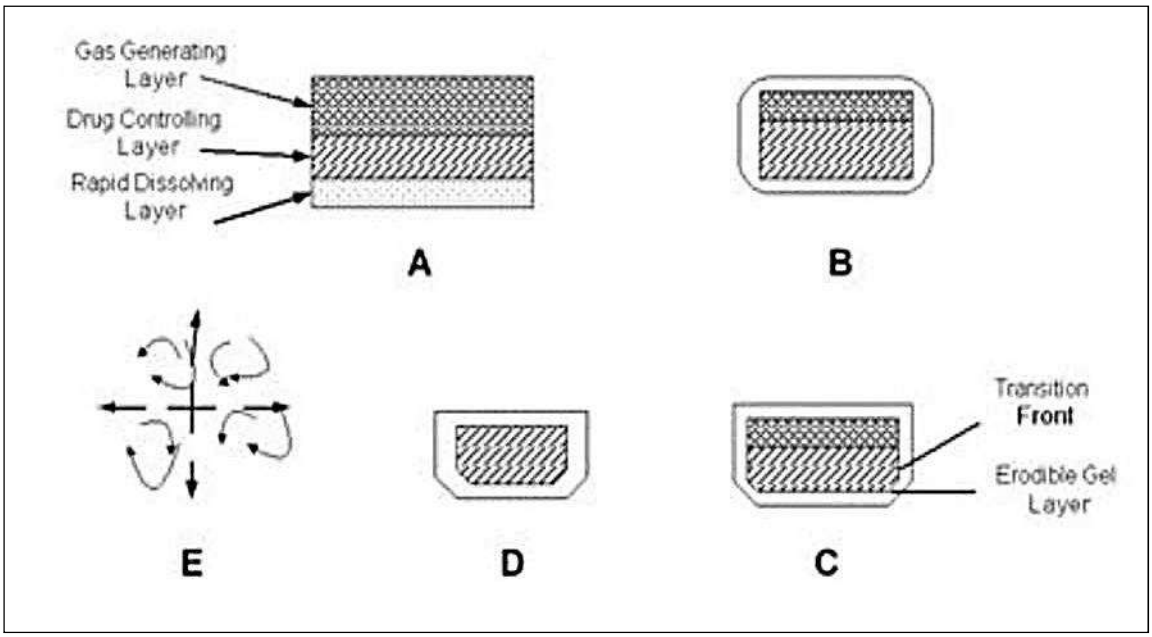


**Figure 1.** Illustrative demonstration of a three-coat setup: (A) Previous composition of three coat tablets, (B) Bismuth layer very fast dissolves and matrix begin to swelling when touch with dissolving liquid, (C) Tablet become larger and destroy (D) and (E) Tablet destroy absolutely (Arora et al., 2005)

by application of $CO_2$ producing delegate like (calcium carbonate and sodium bicarbonate) and watch the affect of $CO_2$ producing on the concrete quality and deliver ratio. The analysis declared that the amount of $CO_2$-generating delegate had found affect on the size, bouncy capacity, aperture image, morphology, deliver ratio, and mechanical strength of the bouncy beads. It was achieved that $CaCO_3$ produced less but stronger beads in comparison to sodium bicarbonate. The $CaCO_3$ was shown to be a low-affective $CO_2$ generating agent than sodium bicarbonate. But it generate best bouncy beads with enhance control of drug deliver ratio. *In -vitro* bouncy analysis declared that the beads free of $CO_2$-generating delegate float in the media.

Recently unsinkable setup using ion exchange resin method was described by supply with a load of bicarbonate into the incorporating beads with 1M sodium bicarbonate solution. The drug load enclosed by semi permeable layer to divert at once lost of carbon dioxide .Whenever going to the touch with abdomen contented then chloride is change into $HCO_3$ ions in that region by producing carbon dioxide after that carrying beads toward the upper part of abdomen contented and provide a unsinkable layer of resin beads. In -vivo behavior of the covering and without covering beads was observed using by gamma radio scintigraphy analysis in 12 healthy people. We confirm this analysis that the abdomen stay duration was longer consider as (24 hr) while without coated beads have as (1 to 3 hours).

**Effervescent fluid enclosed system**

The abdomen stay period of a drug release setup can be constant by including an in bouncy compartment which contains a liquid e.g. ether, cyclopentane, that produce gas at body temperature to cause the in unsinkable of the compartment in the abdomen. The bouncy comportment may also made of a bioerodible stopper consist up of PVA and Polyethylene that slowly soluble resulting from in unsinkable chamber to deliverance gas and break down after definite period to give allow the automatic elimination of the unsinkable systems from the abdomen (Kamalkkannan et al., 2011).

**Non-bouncy unsinkable formulation**

The unsinkable formulation which is non bouncy application a gel forming or swell able cellulose kinds of hydrocolloids, cellulose and matrix-making polymers like polycarbonate, polyacrylate, polymethacrylate, and polystyrene. The procedure of dosage form incorporated a simple approach by mixing the drug and the gel-forming hydrocolloid after that when this formulation swallowing, it is start swelling when going to the touch with abdomen liquid. The airs enclosed within the swollen matrix division buoyancy to the formulation and so make swollen gel-like shape working as a reservoir and allow sustained deliver of drug through the mucilage bulk (Khan et al., 2010).

**Colloidal barrier system**

Recently an hydro dynamically balanced systems consist of a compatible admixture of medicament and the hydrocolloid in a capsule which carry on touch with abdomen liquid acquired and control a bulk density of below than 1. Hence being floating on the abdomen environment until all the drug was delivering (Kumar et al.,

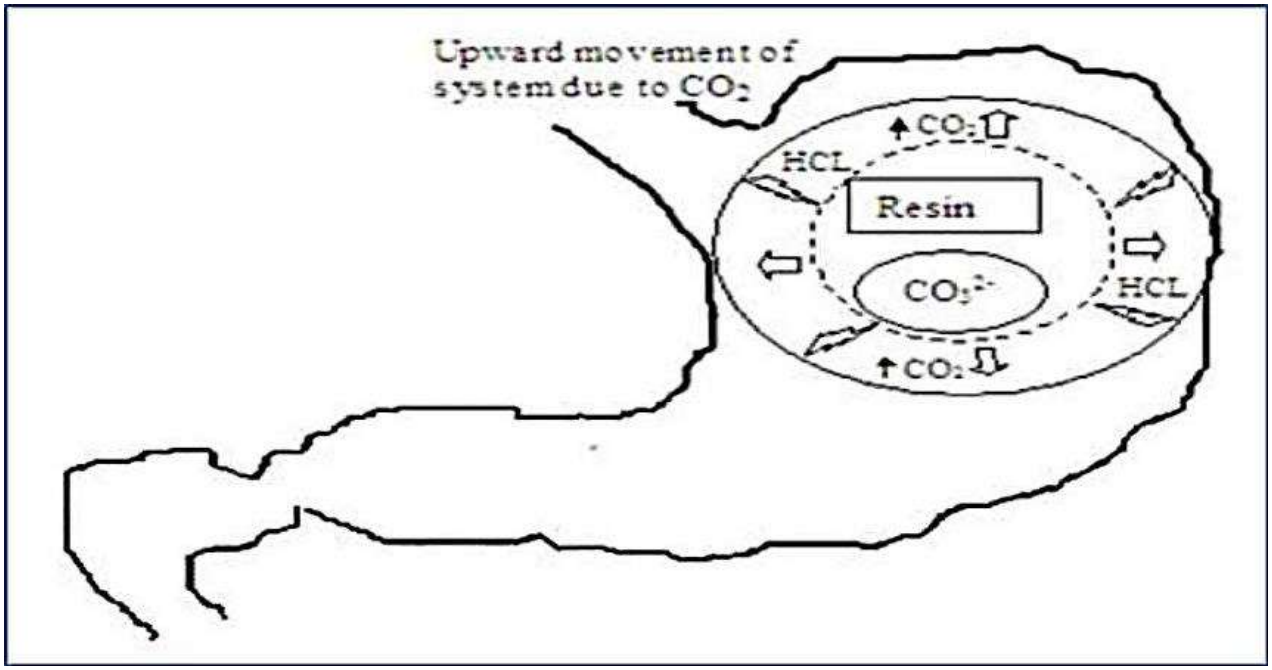


**Figure 2.** Pictorial demonstration of functioning of bouncy unsinkable drug release setup depend on ion exchange resin method (Arora et al., 2005)

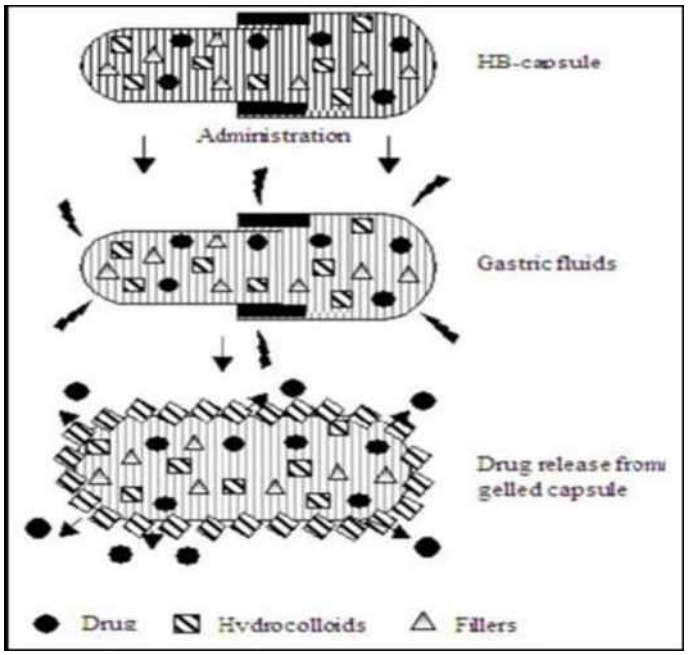


**Figure 3.** Working principles of hydro dynamically balance system (Kumar et al., 2016)

2016). Researcher has worked out on hydro dynamically balance system sustain release tablets which is hydrophilic hydrocolloid when swallowing it is going on the touch with stomach liquid at the body heat make a flexible mucilaginous bulk on the outside of the tablet and give a water-hermetic colloid gel barricade on the outside of the tablets. The drug slowly delivers from the outside of the mucilaginous bulk that stay floating on stomach liquid.

**Micro Porous Compartment System (MPCS)**

MPCS is depends on the filling of drug reservoir within a micro porous chamber with hole along its upper and lower membrane. The external membrane of the drug reservoir chamber are absolutely packed to inhibit any direct touch of the abdomen mucosal layer with the without soluble drug. In abdomen the buoyant compartment enclosed air result the buoyant delivery system above the stomach contented. Abdomen liquid pass through the aperture and dissoluble the carry drug by uninterrupted carrying beyond the intestine for digestion.

***Alginate pearl (beads)***

Multiplex unit buoyant formulation has been prepared from freeze-dried calcium alginate. Round chaplet of approximate 2.5 mm in width can be making by dropping a sodium alginate solution in to aqueous solutions of calcium chloride resulting forming ppt. of calcium alginate. The chaplets are then distributed and very cold in nitrogen liquid and freeze dried at-40°C for 24 hr resulting to the formation of absorptive system which by which a buoyant over the 12 hr.

***Empty (Hollow) microspheres***

Empty microspheres were manufactured by a novel emulsion-solvent diffusion technique in which Ibuprofen cargo into the surrounded polymer shell. The ethanol used in formulation of dichloromethane solution (drug) and an acrylic polymer was poured into an aqueous solution of PVA that was controlled temperature at 40°C.The gaseous stage arising when dispersion of polymer into droplets after vaporization of dichloromethane make an inside cavity in microspheres along with drug and polymer.

**Preparation of buoyant formulation**

There are various kind of the medicament can be included in to HBS formulation.

- Inert fatty material
- Release rate retardant
- Hydrocolloids
- Buoyancy increasing rate
- Release rate accelerants
- Miscellaneous

***Hydrocolloids***

The appropriate complex are synthesize anionic or non ionic like hydrophilic sticky substance, artificial cellulose derivative such as bantonite acacia, gelatin, agar, alginate, sodium carboxy methyl, extract, casein, hydroxy propyl cellulose, veegum, Methyl cellulose, hydroxyethyl cellulose, and sodium , carboxy methyl cellulose can be used. The complex must chemically combined with water molecule in acidic medium i.e. stomach content having pH 1.2. Even though the bulk thickness of the dosage form may be begging more than one but when abdomen liquid is inter in the dosage form it should assure buoyancy if HBS has a bulk density of below than one.

***Inert fatty materials***

Edible pharmaceutical inactive fatlike substance having a particular heaviness less than 1 to be mix into the dosage form for reducing the hydrophilic nature of dosage form and thus enhance the unsinkable. Such as pure beeswax, long chain alcohols, mineral oils, fatty acids and glyceride are used.

***Speed up delivery ratio***

The delivery ratio of the drug from the dosage form can be change incorporating excipients like lactose. This may be present in the out 5-60% by gravity.

**Hinder of delivery ratio**

Without soluble chemical such as Magnesium stearate, di-calcium phosphate and crumb decreased the dissolve

property therefore hinder the delivery of drug.

**Resilience increasing agents**

Material such as EC, C.M.C which has bulk thickness low in comparison to one can be used for increasing the floating of the dosage form. It may become up to 80 % by weight.

**Miscellaneous**

Some pharmaceutically adjuvant like protective, stability and lubricants can be included in the formulation as per the need. They do not unfavorable altered the HBS (Kataria et al., 2011).

**In-vivo quality control of un-sinkable set up (Kamalkkannan et al., 2011)**

The evaluation parameter for floating system includes as follow:

- Geometric Parameter Structure
- Galenic Parameter: Opposite size, adjustability and thickness of matrix,
- Physiological limitation Adolescence, sexuality, condition, diet, goal of health and G.I.T. environment and bioadhesion.
- Control Parameter: Disintegration, duration of buoyant, especial force of attraction and weight variation, content uniformity, stability & friability.
- Buoyant period: The analysis for floating is often carry out in artificial stomach environment and bowel liquid maintained at 37°C.The buoyancy period is decided by using USP dissolution apparatus containing 900 ml of o.1 N HCl as the analysis medium carry on at 37°C.The period for which the formulation buoyant is known as the buoyant period.
- Especial force of attraction Force of attraction of the buoyant can be concluded by the movement technique as an application of benzene like move medium

**Merit of unsinkable formulation**

The basis of hydro dynamically balance system may not disadvantage each specific drug or dashing of drug. The hydro-dynamically balance system dosage form are not prevented to drug which is digestion into abdomen thus it has been found that these are same affect with drug which is digestion into intestine. Acidic nature drug like Aspirin cause irritation on the abdomen layer when come in to touch with it. Hence HBS dosage form may be beneficial for swallowing of the aspirin and other same drugs. The Hydro- dynamically balance system are beneficial those medicament digestion into the stomach such as antacid and Ferrous salts etc. The ability of the swallowing drug by using the sustained release formulation based on principle of HBS found independent of the place of specific drug. The HBS are advantageous for drugs that locally act in the abdomen e.g. Antacids, Sodium bicarbonate. Swallowing of longer release of buoyant formulation such as tablet or capsules dissolved in the gastric fluid and ready for digestion in the small intestine after removing of the abdomen contented. Therefore it is normal that a drug will be complete release from the floating dosage forms it may be stay afloat in the solution at the alkaline pH of the intestine. If faster movement of intestinal then a below transit period such as certain type of diarrhea and digestion is normal. Under this type condition it may be beneficial the drug to keep in buoyant circumstances in abdomen to achieved the best result.

**Demerit of FDDS (Miyazaki et al., 1988)**

- ❖ This system needs a larger amount of liquid in the abdomen for drug float and work efficiently by covering water.
- ❖ FDDS is not good for drugs that have dissolving problems or difficulty in stable in G.I.T.
- ❖ FDDS formulation such as Nifedipine is completely digestion with the entire G.I.T. region and going to first pass metabolism may not be attractive.
- ❖ Drugs which produce irritation to abdomen mucosa layer not good for making FDDS.
- ❖ The drug material that is nothing stable in the acidic medium of the abdomen is not good candidates for formulation of FDDS.
- ❖ The drug should be swallowing with a along with large amount of water (200-250 ml).
- ❖ The FDDS do not advice the merit of the common for drugs which are digestion through the G.I.T.

**Use of unsinkable drug release set up**

Drugs having poor bioavailability the floating drug release give a chance of various uses because of the small digestion aperture in the top division of the G.I.T. It remains the formulation at the point of digestion and therefore increases the bioavailability (Arora et al., 2005).

***Constant drug release***

Hydro dynamically balance system can stay in the abdomen for longer time and thus it can deliver the drug over a longer duration .The difficulty of less abdomen stay period is removed with an oral control release dosage form hence these can be overcome .The principle in which drug have a bulk density of <1 as a result of afloat on the stomach constituents are large amount hence passing from the pyloric opening is prevented (Khan et al., 2010).

Currently sustained release buoyant capsules of Nicardipine hydrochloride were grown after estimation *in* -

*vivo.* The dosage form compared with MICARD capsules present in market and using on hare. After administration of sustained release floating capsules the plasma concentration time curves exhibited a longer duration(16 hr) while sustained release floating MICARD capsules present in market the plasma concentration curve exhibited in less duration (8 hr). Normally a comparative analysis was done between the Madopar HBS and Madopar standard formulation. It was observed that *in vitro* drug deliver up to 8 hr in the previous case and in the second case deliver of drug was basically less in 30 minutes (Arora et al., 2005; Khan et al., 2010).

***Drug release on especial point***

This method is beneficial for that medicine which is definite digestion in abdomen or the next division of the small intestine such as Riboflavin and Furosemide Diuretic drug such as Furosemide is start digestion from the abdomen after that duodenum. It has been mention that a solid buoyant formulation with longer abdomen stay period was grown by increased the bioavailability. Area under curve achieved with the buoyant tablets was nearly 1.8 times in comparison with normal Furosemide tablets. Therefore in present study Furosemide was considered as nodal drug (Khan et al., 2010). Misoprostol is a bilayer-buoyant capsule was prepared for local drug delivery which is artificial clone of prostaglandin E1 used as a protection of stomach lesion caused by swallowing of non steroidal anti inflammatory drug. By goal of unhurried release of misoprostol into the abdomen aspire to therapeutics levels could be obtain and decay of medicine could be decrease (Arora et al., 2005).

**Polyamide and another composition useful in formulation of buoyant drugs**

***Polyamide***

For the formulation of buoyant drug various polymer have been appliance e.g. Eudragit S 100, Eudragit RL. Propylene foam, Hydroxy propyl cellulose , Eudragit RS, ethyl cellulose, Hydroxy propyl methyl cellulose $K^4$ M. Calcium alginate, Methocel $K^4$ M, Polyethylene oxide, Hydroxy propyl methyl cellulose 4000, Hydroxy propyl methyl cellulose 100, Carboxy methyl cellulose, PEG, PC, Poly vinyal alcohol, sodium alginate, HPC-L, CP 934P, HPC, Eudragit S, HPMC Metolose S.M. 100, Polyvinylpyrrolidone, Hydroxypropyl cellulose-H, Hydroxypropyl cellulose -M, Hydroxy propyl methyl cellulose K15, polyox, Hydroxypropyl methyl cellulose $k^4$ Ap, $E^4M$ and CPMM and Cyclodextrin (Dixit et al., 2011).

***Idle fat like delegate*** (5%-75%)

Edible fatty material like edible having a definite weight less than one can be used to diminishing the hydrophilic quality of dosage form and hence improved bouncy E.g. Long chain fatty alcohols, Gelucires 39/01 and 43/01 Beeswax, fatty acids.

***Bouncy delegate***

Di-SGC (Di-Sodium Glycine Carbonate) CG (Citroglycine), Sodium bicarbonate, carbonate, citric acid and tartaric acid.

Quickening delivery ratio (5%-60%) e. g. Mannitol, glucose

***Delay delivery ratio*** (5%-60%) e. g. Magnesium stearate. Talc and Dicalcium phosphate.

***Floating enhancing delegate*** (up to 80%) e. g. Ethyl Cellulose

Not high thickness objective Polypropylene foam powder (Accurel, 1000).

**Future prospects of floating drug delivery systems**

Currently controlled drug delivery dosage form are designing and develop by using natural polymers and their modified form such as fenugreek and tamarind gum and many more (Shukla et al., 2017, Shukla et al., 2018, Shukla et al., 2019). In addition clinical study between medicine and dosage form in conjunction of various small digestion aperture that is profit in manufacturing of FDDS. Changing parental administration of medicine to oral pharmacological therapy would considerable to enhance cure. It is expected that buoyant drug release theory may increase this hope. It is anticipated that the buoyant drug release theory concept may be applicable for several potentially effective agent with small digestion aperture whose growth has been stop due to deficiency of suitable pharmaceutical buoyant drug release theory and methodology. For remedy of H. Pylori infection developed a single FDDS due to their requirement. Another investigation may finish on the following approach:

- Naming of a minimum cut-off size over that dosage form stay into abdomen for longer duration. This would allow a much categorical inhibition to be gets in duration of stomach stay.
- Making of FDDS and each having a small GRT for application and allow to the clinical requirement such as disease state and dosage form. This may be achieved by synthesize polymeric matrix with many biodegradation properties.
- The analysis on the affect of different geometric structure in a unreasonable aspect than prior analysis increase dimensions with high toughness on gastric retention time. New polymer formed according to pharmaceutical and scientific need.

**Table 1.** Some marketed products of FDDS (Ushimaru et al., 1987)

| S. No. | Brand Name | Drug & Dose | Remarks | Company/Country |
|---|---|---|---|---|
| 1 | Topalkan | Al -Mg antacid | Floating liquid alginate | Pierre Fabre Drug, France |
| 2 | Conviron | Ferrous sulfate | Colloidal gel forming FDDS | Ranbaxy,India |
| 3 | Liquid Gaviscon | Aluminium hydroxide( 95 mg) Magnesium carbonate (385 mg) | Effervescent floating liquid preparation | Glaxo Smithkline,India |
| 4 | Madopar | Levodopa (100 mg) Benserazide (25 mg) | Floating, CR capsule | Roche products, USA |
| 5 | Almagate Float Coat | Al -Mg antacid | Floating liquid form | Pierre Fabre Drug France |
| 6 | Valrelease | Diazapam (15 mg) | Floating capsule | Hoffmann-La Roche USA |
| 7 | Cifran OD | Ciprofloxacine (1 g) | Gas generating floating form | Ranbaxy, India |

## Conclusion

Evacuating of gastric, the dosage forms is an extremely variable process and is the capability to prolong and control the evacuating period which is a valuable asset for dosage forms, which remain in the stomach for a longer period of time in comparison to conventional formulation. Gastro retentive floating granules of Furosemide were prepared with a purpose to provide the drug for prolonged period of time in the gastric region. Furosemide was targeted to stomach because it has the absorption window in upper part of GIT. The floatation was accomplished by including polymer like gelucire 43/01, HPMCK4 100. FTIR evaluation of the pure drug and formulations indicate that there was no drug polymer interaction. The physico chemical properties of all the formulations were found to be within the prescribed official limits. The increase in polymer concentration and viscosity causes retarding of the drug release. Formulations containing higher polymer concentration had slower drug release when compared to formulations with lower concentration of polymers. From all the formulation F4 formulation showed better release profile and extended the drug release for longer duration of time. Hence F4 formulation is optimized. The drug release pattern from the optimized formulation followed zero order kinetics.

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