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An introduction to floating microspheres: A technique of gastro retentive drug delivery system

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Abstract
The G.I.T. transit time of a dosage form needs to be controlled in order to get maximum benefit of therapeutic agent contained in it and to develop sustained release formulation. Floating microspheres are one of the tried method which increase the stay time of the drug in stomach by virtue of low density, the buoyancy of microspheres is increased which make them floating in gastric fluid. Floating microspheres are gaining special attention because they remain buoyant and distribute drug uniformly in stomach, increase bioavailability of drug that are unstable at intestinal pH. The concept of this dosage form has also been utilized to reduce irritant effect of drug in stomach as the direct contact with gastric mucosa is reduced. Gastro retentive floating microspores provide continuous release of drug from a dosage form, with variation in ingredients added they can achieve various release patterns. The present review brings together the essentials of floating microspheres to form gastro retentive drug delivery system. It concisely gives information on physiology of gastric emptying system in correlation to floating drug delivery system.

Keywords: Floating microspheres, buoyant, bioavailability, GRDDS, GIT, GRT

Introduction
Oral route is the most popular and successful route for various drugs and dosage forms because of its convenience and ease of administration. Oral route also receives more attention because of flexibility in dosage form designing and low production cost. Various factors which affect oral drug delivery design are type of delivery system, disease being treated, patient, the length of the therapy, and the properties of drug. Oral drug delivery system can be classified as fast release and the controlled release systems. The fast release dosage forms leads to fluctuation in drug plasma level which cause under medication or over medication. Controlled release dosage forms are developed to overcome this problem. Various forms of controlled release dosage forms are delayed release, extended release, programmed release and site specific release type of dosage forms [1].

Release of the drug from delivery system from the site of release is one of most important variable for development of successful oral dosage form. In case of oral controlled drug delivery system the drug should be absorbed continuously throughout the GIT, by passive diffusion. But unfortunately, in most cases gastrointestinal tract variability of physiology and transit time leads to unpredictable bioavailability and non-reproducible therapeutic effects. Most of the drugs are absorbed well throughout the intestinal tract, but some compounds suffer from narrow absorption window i.e. they degrade at the high pH level of intestine. Drug absorption from GIT is a complex procedure, and one of the difficulties is to confine the extent of the drug at the specific area of GIT. This is mainly affected by the condition of gastric emptying which is very complex process. To address this problem Gastro retentive drug delivery system (GRDDS) are developed which have the ability to prolong and control emptying time. Gastro retentive drug delivery system delivers the drug in stomach or in the upper part of intestine [2, 3].

The GRDDS can be defined as the site specific drug delivery system which delivers the drug by retention of dosage form in the stomach and the drug is released to the specific site i.e. either in stomach, duodenum or in upper intestine in a control manner. This rate-controlled oral drug delivery system reduces fluctuation in drug plasma concentration by prolongation of gastric residence time of drug. It reduces the dose requirement and frequency of dose along with improvement of the solubility of drugs that are less soluble in a high pH environment by prolongation in over all gastric residence time. The development of gastro retentive dosage forms capable of staying in the stomach over an extended period of time may be particularly useful for drugs that may act locally in the stomach e.g., antacid, antibiotics,

drugs that are absorbed primarily in the stomach, e.g., albuterol, chlordizepoxide; drugs that are absorbed rapidly from the GI tract, e.g., amoxicillin; drugs that have a narrow absorption window and are (mainly) absorbed from the upper small intestine, e.g., ofloxacin, levodopa, riboflavin, theophylline; drugs having low bioavailability and drugs that degrade in the colon, e.g., ranitidine, metoprolol; and drugs that are poorly soluble in intestinal pH, e.g., diazepam, weak bases such as dipyridamole [4].

Gastro retentive systems deliver drugs for local or systemic effects. On the basis of the mechanism of mucoadhesion, floatation, sedimentation or by the simultaneous administration of pharmacological agents, the controlled gastric retention of solid dosage form may be achieved, which delay gastric emptying. It greatly improves the pharmacotherapy of the stomach through local drug release, leading to high drug concentration at the gastric mucosa. (For e.g. Eradicating Helicobacter pylori from the sub mucosal tissue of stomach) making it possible to treat stomach and duodenal ulcers, gastritis and oesophagitis, reduce the risk of gastric carcinoma and administer non-systemic controlled release antacid formulations (calcium carbonate). GRDD can be used as carriers for drugs with low absorption windows. These substances for eg: antiviral and antifungal (Sulphonamides, Quinolones etc.) are taken up only from very specific sites of GI mucosa. In general, appropriate candidates for controlled release gastroretentive dosages form are molecules that have poor colonic absorption but are characterized by better absorption properties at the upper parts of the GIT [5, 6].

Gastro retentive drug delivery system (GRDDS) are developed on various approach such as floating systems, swelling and expanding systems, modified-shape systems, bioadhesive systems, high density systems and other delayed gastric emptying devices are used for gastric retention [7, 8, 9].

Advantages of Gastro Retentive Drug Delivery Systems are

- Improvement of bioavailability and therapeutic efficacy of the drugs, e.g. Furosemide
- Maintenance of constant therapeutic levels over a prolonged period and thus reduction in fluctuation in therapeutic levels minimizing the risk of resistance especially in case of antibiotics. e.g. β-lactam antibiotics (Penicillins and Cephalosporins)
- Retention of drug delivery systems in the stomach.
- Increased gastrointestinal transit time thereby increasing bioavailability of sustained release delivery systems intended for once-a-day administration e.g. Ofloxacin.
- Site specific delivery can be achieved in the stomach.
- Minimize the adverse activity in the colon by minimizing the amount of drug that reaches the colon.

Disadvantages of Gastro Retentive Drug Delivery System are

- Not suitable for the drug which cause gastric irritation.
- The major disadvantage of floating system is requirement of a sufficient high level of fluids in the stomach for the drug delivery to float.
- Gastric- retention is influenced by many factors such as gastric motility, pH and presence of food. These factors are never constant and hence the buoyancy cannot be predicted.
- High variability in gastric emptying time due to its all or non emptying process.
- Patients should not be dosed with floating forms just before going to bed.
- Floating system is not feasible for those drugs that have solubility and stability problem in gastric fluids.

Suitable Drug candidates for Gastro Retentive Drug Delivery System are

- Drugs acting locally in the stomach, e.g. Antacids and drugs for H. Pylori.
- Drugs that are primarily absorbed in the stomach, e.g. Amoxicillin.
- Drugs that is poorly soluble at alkaline pH, e.g. Furosemide, Diazepam, Verapamil.
- Drugs with a narrow window of absorption, e.g. Cyclosporine, Methotrexate, Levodopa.
- Drugs which are absorbed rapidly from the GI tract, e.g. Metronidazole, Tetracycline.
- Drugs that degrade in the colon, e.g. Ranitidine, Metformin HCl.
- Drugs that disturb normal colonic microbes, e.g. antibiotics against Helicobacter pylori.

Drugs unsuitable for Gastro Retentive Drug Delivery System are

- Drugs that have very limited acid solubility, e.g. Phenytoin etc.
- Drugs that suffer instability in the gastric environment, e.g. Erythromycin etc.
- Drugs intended for selective release in the colon, e.g. 5-amino salicylic acid and corticosteroids etc.

Gastric Empting Process

The stomach is muscular, hollow, dilated part of the alimentary canal which is a bag like structure having a smooth mucosa and thus small surface area. The stomach store food temporarily, grind it and release it slowly to the duodenum. It has acidic pH due to HCl secretion, which favors absorption of acidic drugs, since they are unionized and soluble in the gastric fluids [10].

The stomach is divided into three region according to anatomy i.e., funds, body and antrum (pylorus). The proximal part act as a reservoir for undigested material which is made of funds and body, as well as mixing motion is done by antrum which is mainly responsible for the gastric emptying, through propelling action. Gastric emptying occurs in both conditions, fasting as well as fed state. The pattern of motility is however distinct in the two states. An inter digestive series of electrical events take place, which cycle both through stomach and intestine every 2 to 3 hours during fasting state. This is called the inter digestive myoelectric cycle or migrating myoelectric cycle (MMC), which is further divided into 4 phases [11].

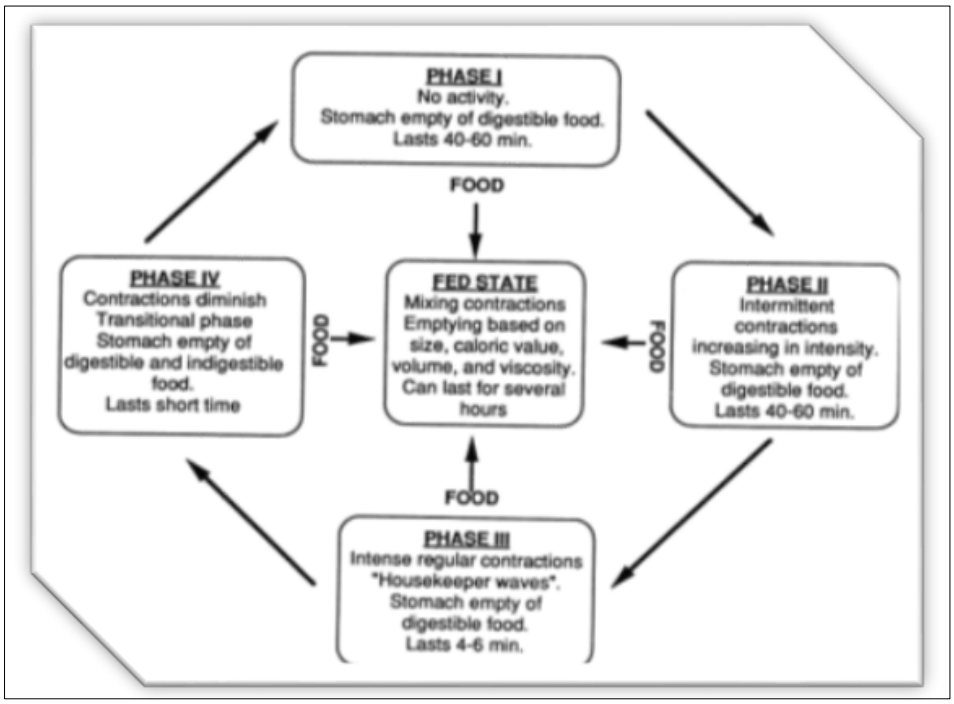
Phase I (Basal phase): lasts from 40 to 60 minutes with rare contractions.

Phase II (Preburst phase): lasts for 40 to 60 minutes with intermittent action potential and contractions. As the phase progresses the intensity and frequency also increases gradually.

Phase III (Burst phase): lasts for 4 to 6 minutes. It includes intense and regular contractions for short period. It is due to

this wave that all the undigested material is swept out of the stomach down to the small intestine. It is also known as the Housekeeper waves.

Phase IV: lasts for 0 to 5 minutes and occur between phases III and 1 of 2 consecutive cycles. After the ingestion of a mixed meal, the pattern of contractions changes from fasted to that of fed state. This is also known as digestive motility pattern and comprises continuous contractions as in phase II of fasted state. These contractions result in reducing the size of food particles (to less than 1 mm), which are propelled toward the pylorus in a suspension form. During the fed state onset of MMC is delayed resulting in slowdown of gastric emptying rate. Scintigraphic studies determining gastric emptying rates revealed that orally administered controlled release dosage forms are subjected to basically two complications, that of short gastric residence time and unpredictable gastric emptying rate.

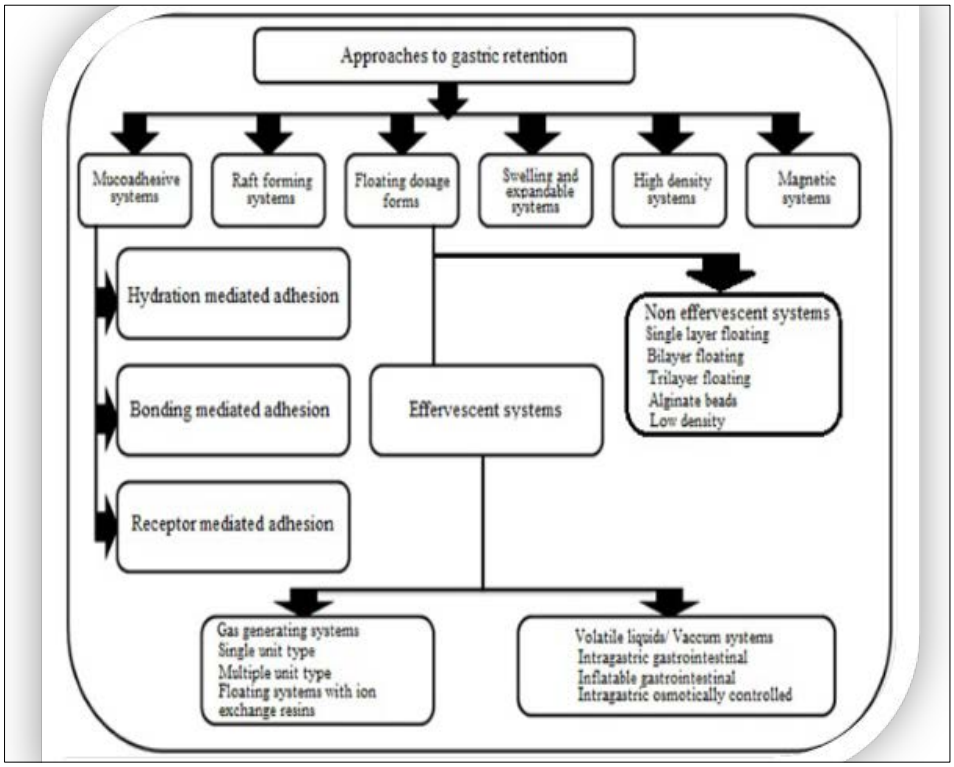


Factors Affecting Gastric Retention Time (GRT): A number of factors control the effectiveness (bioavailability) and efficacy of GRDDS are:-

- **Density:** Density of the dosage form should be less than the density of gastric content (1.004gm/ml).
- **Size:** Dosage forms with the diameter more than 7.5mm are reported to have greater gastric retention time.
- **Fed or Unfed State:** Under fasting conditions, the GI motility is characterized by periods of strong motor activity or the migrating myoelectric complexes (MMC) that occurs every 1.5 to 2 hours. The MMC sweeps undigested material from the stomach and if the timing of administration of the formulation coincides with that of the MMC, the GRT of the unit can be expected to be very short. However, in the fed state, MMC is delayed and GRT is considerably longer.
- **Volume of meal:** Larger the bulk of the meals, longer the gastric emptying time.
- **Nature of the meal:** Feeding of indigestible polymers of fatty acid salts can change the motility pattern of the stomach to a fed state, thus decreasing the gastric emptying rate and prolonging the drug release.
- **Caloric Content:** GRT can be increased between 4 to 10 hours with a meal that is high in proteins and fats.
- **Physical state and the viscosity of meal:** Liquid meals take less than an hour to empty whereas a solid meal may take as long as 6 to 7 hours. Viscous material empty at a slow rate in comparison to less viscous material.
- **Temperature of the meal:** High or low temperature of the ingested fluid to the body temperature reduces the gastric emptying rate.
- **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.
- **Gender:** Gastric residence time in males (3.4±0.4 hours) is less as compare to female (4.6±1.2 hours), regardless of the weight, height and body surface. So dosage form does not retain in male for longer duration of time in stomach as compared to female.
- **Age:** Elderly people, especially those over 70 years have a significantly longer GRT.
- **Posture:** GRT can vary between supine and upright ambulatory states of the patients.
- **Concomitant drug administration:** Anticholinergic like Atropine and Propantheline opiates like codeine and prokinetic agents like Metoclopramide and Cisapride decrease gastric motility and increase gastric residence time [12].

Floating Drug Delivery System

Floating drug delivery systems are the system which have the lesser density than the gastric fluid (<~1.004g/cm^3) and thus remain buoyant in the stomach without affecting the gastric emptying rate for a prolonged period. The drug is slowly released at a desired rate from the floating system and after the complete release the residual system is expelled from the stomach. Single or multiple unit systems have been used for the design of FDDS [13].



Classification of Floating Drug Delivery Systems

Floating drug delivery systems can be classified into two types [14]

- Effervescent systems
- Volatile liquid containing systems
- Gas-generating Systems
- Non-Effervescent Systems
- Colloidal gel barrier systems
- Microporous Compartment System
- Alginate beads
- Hollow microspheres

Effervescent Floating Dosage Forms

This approach provides floating drug delivery systems based on the formation of CO2 gas. It utilizes effervescent components such as sodium bicarbonate (NaHCO3) or sodium carbonate, and additionally citric or tartaric acid. Upon contact with the acidic environment, a gas is liberated, which produces an upward motion of the dosage form and maintains its buoyancy. A decrease in specific gravity causes the dosage form to float on the chyme. Generally effervescent systems suffer from the disadvantage not to float immediately after swallowing because the process of gas generation takes some time. Therefore, they could be cleared from the stomach before becoming effective. The performance of low-density, floating drug delivery systems is strongly dependent on the filling state of the stomach [15].

Non-Effervescent Floating Dosage Forms

This type of system, after swallowing, swells unrestrained via imbibitions of gastric fluid to an extent that it prevents their exit from the stomach. These systems may be referred to as the 'plug type systems' 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 [16].

Colloidal gel barrier system

These systems contains drug with gel-forming hydrocolloids meant to remain buoyant on the stomach content. These are single-unit dosage form, containing one or more gel-forming hydrophilic polymers. Hydroxypropyl methylcellulose (HPMC), hydroxethyl cellulose (HEC), hydroxypropyl cellulose (HPC), sodium carboxy methyl cellulose (NaCMC), poly carbophil, polyacrylate, polystyrene, agar, carrageenans or alginic acid are commonly used excipients to develop these systems. The polymer is mixed with drugs and usually administered in hydro dynamically balanced system capsules. The capsule shell dissolves in contact with water and mixture swells to form a gelatinous barrier, which imparts buoyancy to dosage form in gastric juice for a long period. Because, continuous erosion of the surface allows water penetration to the inner layers maintaining surface hydration and buoyancy to dosage form [17].

Microporous compartment system

This approach is based on the principle of the encapsulation of a drug reservoir inside a microporous compartment with pores along its top and bottom walls. The peripheral walls of the device were completely sealed to prevent any direct contact of the gastric surface with the undissolved drug. In the stomach the floatation chamber containing entrapped air causes the delivery system to float in the gastric fluid. Gastric fluid enters through the aperture, dissolves the drug and dissolved drug moves for continuous transport across the intestine for drug absorption [18].

Alginate beads

Multiple unit floating dosage forms have been developed from freeze-dried calcium alginate. Spherical beads of approximately 2.5 mm in diameter can be prepared by dropping sodium alginate solution in to aqueous solutions of

calcium chloride, causing precipitation of calcium alginate. The beads are then separated snap and frozen in liquid nitrogen, and freeze dried at -40° for 24 h, leading to the formation of porous system, which can maintain a floating force over 12 h.

Hollow microspheres or floating microsphere

Floating microspheres are gastro-retentive drug delivery systems based on non-effervescent approach. Hollow microspheres (microballoons) are in strict sense, spherical empty particles without core. These microspheres are characteristically free flowing powders consisting of proteins or synthetic polymers, ideally having a size less than 200μm. Solid biodegradable microspheres incorporating a drug dispersed or dissolved throughout particle matrix have the potential for controlled release of drugs. Gastro-retentive floating microspheres are low density systems that have sufficient buoyancy to float over gastric contents and remain in stomach for prolonged period. As the system floats over gastric contents, the drug is released slowly at desired rate resulting in increased gastric retention with reduced fluctuations in plasma drug concentration. Hollow microspheres loaded with drugs in their other polymer shelf were prepared by simple solvent evaporation or solvent diffusion or solvent evaporation methods to prolong the gastric retention time (GRT) of the dosage form with continuously floating over the surface of an acidic dissolution media containing surfactant for more than 12 h [19].

Method of Preparation of Floating microsphere

Solvent Evaporation Method

The polymer is dissolved in an organic solvent and the drug is either dissolved or dispersed in the polymer solution. The solution containing the drug is then emulsified into an aqueous phase containing suitable additive (surfactants or polymer) to form oil in water emulsion. After the formation of a stable emulsion, the organic solvent is evaporated either by increasing the temperature under pressure or by continuous stirring. The solvent removal leads to polymer precipitation at the oil-water interface of droplets, forming cavity and thus making them hollow to impart the floating properties. The polymers studied for the development of such systems include cellulose acetate, chitosan, eudragit, acrycoat, methocil, polyacrylates, polyvinyl acetate, carbopol, agar, polyethylene oxide and polycarbonate.

Emulsion solvent diffusion method

Floating microspheres with drug in their outer polymer shell prepared by novel emulsion solvent diffusion method. Based on eudragit-S (an enteric polymer), containing the drug in the polymeric shell. A solution of polymer and drug in ethanol methylene chloride is poured into an agitated aqueous solution of poly (vinyl alcohol). The ethanol rapidly partitions into the external aqueous phase and the polymer precipitates around methylene chloride droplets. The subsequent evaporation of the entrapped methylene chloride leads to the formation of internal cavities within the micro particles.

Spray drying

Spray drying is the most widely employed industrial process for particle formation and drying. It is an ideal process where the required particle size distribution, bulk density and particle shape can be obtained in a single step. First of all, polymer is dissolved in a suitable volatile organic solvent such as dichloromethane, acetone etc. to form a slurry. The slurry is then sprayed into the drying chamber, concentration gradient of the solute forms inside the small droplet with the highest concentration being at the droplet surface. This is because the time of the solute diffusion is longer than that of the solvent in the droplets evaporating during the drying process. Subsequently, a solid shell appears leading toward formation of microspheres. Separation of the solid products from the gases is usually accomplished by means of a cyclone separator while the traces of solvent are removed by vacuum drying and the products are saved for later use [20].

Formulation Aspects of Floating Drug Delivery Systems

Drugs: Drug having better solubility in acidic environment, stability at gastric pH and also having specific site of absorption in the upper part of the small intestine are suitable candidate for FDDS. Drugs which having shorter biological half life are suitable candidate for the FDDS formulations. Drugs that are used locally in stomach like ranitidine hydrochloride, famotidine (H2-receptor antagonist), widely used/prescribed in duodenal ulcers, gasric ulcers, zollinger ellisons syndrome, gastrooesophageal reflex disease and erosive esophagitis are suitable candidate for FDDS.

Polymer: Low density polymers which have bulk density less than one, can be used for enhancing the buoyancy of the FDDS formulation.

Solvent: Solvent system should be so chosen that it should yield good microspheres. Generally, water miscible organic solvents are chosen. It should have good volatile properties, so that it easily come out from the emulsion leaving hollow microspheres. e.g. ethanol, dichloromethane (DCM), acetonitrile, acetone, isopropyl alcohol (IPA), dimethylformamide (DMF).

Processing medium: The processing medium is used to harden the drug-polymer emulsified droplets. It should be such that it should give spherical droplets when the drug-polymer solution is poured into it, should not interact with the former, mainly used are liquid paraffin, polyvinyl alcohol and water.

Surfactant: These are used as stabilizers or emulsifiers, play the role of hardening the microspheres as well. e.g. tween 80, span 80 and SLS.

Cross linking agent: Chemical cross-linking of microspheres can be achieved using cross linking agents such as formaldehyde, glutaraldehyde, etc. The method is limited to drugs that do not have any chemical interaction with the cross-linking agent.

Hardening agent: This helps to harden the microspheres formed in the processing medium. e. g. n-hexane, petroleum ether (in case the processing medium is liquid paraffin) [21, 22, 23].

Characterization of Floating Microsphere

1. **Micromeritic Properties-** The microspheres are characterized by the particle size, bulk density, tapped density, compressibility index, hausner's ratio and angle of repose.
   - **Particle Size:** particle size of floating microsphere can be determined by using the optical microscopic method with

the help of calibrated eye piece micrometer. In this method suspension of floating microsphere was prepared and a drop of suspension is mounted on a slide and about 600 particles measured with the help of the eye piece micrometer.

- **Bulk Density:** microsphere are accurately weighed and filled into the measuring cylinder and the volume of the cylinder were note down. This volume is bulk volume which includes the true volume of the powder and the void space among the microspheres.

- Bulk density = $\frac{\text{Mass of microsphere}}{Volume\ of\ microsphere}$

- **Tapped Density:** In this method floating microsphere were transferred to a measuring cylinder and taped for 100 times. After tapping volume of microsphere is observed and the ratio of mass of microspheres to volume of microspheres after tapping gives tapped density.

Tapped Density=$\frac{Mass\ of\ Microspheres}{Volume\ of\ Microspheres\ after\ Tapping}$

- **Compressibility Index:** The flowability of powder can be evaluated by comparing the bulk density (ρo) and tapped density (ρt) of powder and the rate at which it packs down. Compressibility index is calculated by

- Compressibility Index = $\frac{Tapped\ Density - Bulk\ Density}{Tapped\ Density}$ x 100

- **Hausner's Ratio:** Hausner's ratio of microsphere is determined by comparing tapped density to bulk density as follows

- Hausner's Ratio=$\frac{Bulk\ Density}{Tapped\ Density}$

- **Angle of Repose:** The frictional forces in a loose powder or granules can be measured by angle of repose. This is the maximum angle possible between the surface of a pile of powder or granules and the horizontal plane. The granules were allowed to flow through the funnel fixed to a stand at definite height (h). The angle of repose was then calculated by measuring the height and radius of the heap of granules formed.

- $\theta = Tan^{-1}(h/r)$

2. **Yield of floating microspheres:** The prepared floating microspheres is collected and weighed. The measured weight is divided by total amount of all non-volatile components which were used for the preparation of microspheres.

Percentage Yield = $\frac{Actual\ wieght\ of\ microsphere}{Total\ wieght\ of\ non-volatile\ components}$ x 100

3. Percentage of drug entrapment can be calculated by the following equation.

- Percentage Drug Entrapment =$\frac{Amuont\ of\ Drug\ Present\ in\ Formulation\ Practically}{Theoratical\ Amount\ of\ Drug\ in\ Formulation}$ x 100

4. **Buoyancy percentage:** Appropriate amount of Microspheres is placed in 900 ml of 0.1 N hydrochloric acid. The mixture is stirred at 100 rpm in a dissolution apparatus for 8 hrs. After 8 hrs, the layer of buoyant microspheres are separated by filtration. Particles sinking in the particulate layer are separated by filtration. Particles of both types are dried in a desiccator until constant weight. Both the fractions of microspheres were weighed and buoyancy was determined by the weight ratio of floating particles to the sum of floating and sinking particles.

- Percentage Buoyancy = $\frac{\text{Weight of floating microsphere}}{\text{Total weight of floating and sinking microspheres}}$ x 100

5. ***In vitro* release studies:** *In vitro* dissolution studies can be carried out in a USP paddle type dissolution assembly. Microspheres equivalent to the drug dose are added to 900 ml of the dissolution medium and stirred at 100 rpm at 37 ± 0.5 °C. Samples are withdrawn at a specified time interval and analyzed by UV Spectroscopy.

6. **Scanning Electron Microscopy (SEM):** The external and internal morphology of the microspheres can be studied by Scanning Electron Microscopy (SEM) [24, 25, 26].

Advantages of Floating Microsphere

- Reduces the dosing frequency and there by improve the patient compliance.
- Better drug utilization and reduce the incidence or intensity of adverse effects because fluctuations in plasma drug concentration is avoided, a desirable plasma drug concentration is maintained by continuous drug release.
- Floating microspheres are used to decrease material density and gastric retention time is increased because of buoyancy.
- Drug releases in controlled manner for prolonged period.
- Superior to single unit floating dosage forms such microspheres releases drug uniformly and there is no risk of dose dumping.
- Avoidance of gastric irritation, because of controlled release effect.
- Better therapeutic effect of short half-life drugs can be achieved.

Disadvantages of Floating Microsphere

- The release rate of the controlled release dosage form may vary from a variety of factors like food and the rate of transit though gut.
- Differences in the release rate from one dose to another because of non-uniform drug entrapment during the formulation. It may show batch to batch variation.

Applications of Floating Microspheres

- Floating microspheres are used to deliver the drug at localized site of GI mucosa.
- They are suitable drug delivery system for drug having

narrow absorption window like quinolones, penicillins, cephalosporins, aminoglycosides.
- Controlled or delayed release system can be designed for the drugs producing gastric irritation.
- Targeted Drug delivery may be designed in Floating microspheres like magnetic microsphere.
- Floating microspheres can be used for diagnostic purpose like radioactive microsphares.

Conclusion

Oral route is the most preferred route of administration. Oral controlled drug delivery system are being developed and marketed for improving patient compliance. Successful oral controlled dosage form should be properly absorbed throughout G.I.T. without producing harsh/irritating effect on mucosa of G.I.T. Gastric emptying of dosage form has been up taken as a tool for development of prolonged release dosage form. Gastro retentive dosage form increases residence time of drug in G.I.T. They can provide rate controlled drug delivery, may reduce "peak and valley" effect, increase bioavailability for entities which exhibit narrow absorption window. Floating microspheres and development of gastro retentive dosage form may been useful for drug like antacids, antibiotics for ulcers, drugs which are unstable in intestinal pH & colon and for drugs that are irritating to gastric mucosa. Floating microspheres have good ability to enhance gastro retention so as to enhance bioavailability & stability of drugs. Many drugs have been successfully tried and formulated as floating microspheres by researcher yet their portion in market needs to be increased.

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