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Review Article

Review on Floating Drug Delivery System

Kavita Sahu¹, Aditya Kumar², Tarini Sahu³, Trusha Marsoniya⁴, Dikeshwar Verma⁵, Suchita Wamankar^{*6}, Dr. Rajesh Kumar Nema⁷

^{1,2,3,4} Rungta Institute of Pharmaceutical Sciences and Research, Kohka, Kurud, Bhilai, India ^{5,6,7} Rungta Institute of Pharmaceutical Sciences, Kohka, Kurud, Bhilai, India

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ABSTRACT

Floating Drug Delivery Systems (FDDS) represent a promising approach to enhance the bioavailability and controlled release of drugs, especially those that are absorbed in the upper gastrointestinal tract or require prolonged gastric retention. This review explores the fundamental concepts, classification, mechanisms, advantages, disadvantages, and applications of FDDS. The system relies on buoyant dosage forms that float on gastric fluids, thereby extending gastric residence time and improving drug absorption. Effervescent and non-effervescent systems, along with raft-forming and hollow microsphere technologies, are discussed in detail. The paper also outlines physiological factors affecting gastric retention, criteria for drug selection, and the challenges associated with FDDS. Advances in formulation techniques and polymer science continue to support the development of effective gastro-retentive drug delivery platforms, offering better therapeutic outcomes and improved patient compliance.

INTRODUCTION

The oral bioavailability of several pharmaceutical medications with an absorption window in a specific area of the gastrointestinal (GI) tract can be enhanced with the help of gastro-retentive drug delivery systems (GTDDS). The goal of designing a new oral controlled drug delivery system should be to maximize the drugs' pharmacological action at the intended location. Feasible dose options that can be supplied thru numerous routes of administration were made viable by recent technological advancements. There are numerous one-of-a-kind ways to provide drugs, consisting of oral, topical, nasal, rectal, vaginal, and ophthalmic, amongst others. However, amongst those methods, oral remedy shipping is visible to be the most popular and frequently applied approach for the following motives: Low price, simplicity of production, and ease of administration. The

*Corresponding Author: Suchita Wamankar

Email : suchitawamankar@gmail.com

Address: Rungta Institute of Pharmaceutical Sciences, Kohka, Kurud, Bhilai, India

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medicines that could be acquired from the stomach or have a localized impact should be inside the stomach for as long as viable. But, it is proven that with normal dosage bureaucracy, that is extremely not going to happen. The most promising approach is thought to be administering medications oral. Handiest when taken sever an instances an afternoon can a traditional drug transport system attain and sustain the drug awareness inside the therapeutically powerful variety required for treatment. [1] [2] These day innovative drug transport techniques have emerged which have the capacity to transform remedy shipping and provide numerous therapeutic blessings. Which will launch the medication gradually into the Gastrointestinal Tract (GIT) and sustain an effective drug concentration inside the systemic stream for a prolonged period of time, oral sustained-managed release formulations had been advanced. Drugs that are absorbed from the stomach or have a localized impact have to be within the stomach for so long as feasible. But, its miles proved that with normal dosage forms, this is extremely unlikely to happen.



Fig.Presentation of Floating System in GIT

1. FLOATING DRUG DELIVERY SYSTEM

Floating drug delivery systems (FDDS) are invented to keep the drug inside the belly and are relevant for capsules with poor solubility and low stability in intestinal fluids. The idea behind FDDS is making the dosage form less dense than the gastric fluids to make it float on them. FDDS are

hydro dynamically controlled low-density systems with sufficient buoyancy to float over the gastric contents and remain buoyant within the stomach without affecting the gastric emptying rate for an extended time frame. The residual system is emptied from the belly with the discharge of the drug. This results in greater gastric residence time and better control over plasma drug concentration fluctuations. The principle of buoyant training provides a simple and practical method to achieve improved gastric residence time for the dosage form and sustained drug release. Prolonging the gastric retention of a delivery system is ideal for achieving greater therapeutic efficacy of the drug substance under certain conditions. For example, pills that show better absorption in the proximal part of the gastrointestinal tract and tablets with low solubility that degrade in alkaline pH are effective in prolonging gastric retention. Similarly, for sustained drug delivery to the stomach and proximal small intestine in treating certain ulcerative conditions, extended gastric retention of the therapeutic moiety provides numerous benefits, including improved bioavailability, therapeutic efficacy, and reduction of dosing frequency.^[10]

CLASSIFICATION OF FLOAT ING DRUG DELIVERY SYSTEM

1. Effervescent system

Effervescent systems include use of gas generating retailers, carbonates (e.g. Sodium carbonate) and opportunity natural acid (e.g. acid and salt acid) present within the formulation to supply CO2 fuel so lowering the density of device and growing it float at the gastric fluid.an trade the incorporation of matrix containing part of liquid that manufacture gas that evaporate at body temperature^{. [12][13]}

(A) Gas generating systems



Those are formulated by way of intimately blending the CO2 generating dealers and the drug in the matrix pill. These have a bulk density decrease than gastric fluids and consequently stay floating in the stomach unflattering the gastric emptying charge for a prolonged duration.

(B) Volatile liquid vacuum containing structures

This machine is created to drift inside the abdomen owing to floatation chamber which can be a vacuum or complete of air or harm less gas, whereas drug reservoir is encapsulated with in a micro porous compartment.

2. Non- effervescent machine

This kind of gadget whilst swallowing swell unrestrained via inhibitions of viscous fluid to partner volume that it prevents their exit from the stomach. Those systems can also be remarked because the plug type gadget since they want an unethical to stay lodged near pyloric valve. one in every of system strategies of such indefinite amount paperwork involves the blending of drug with a gel that swells worried with viscous fluid while oral administration and preserves a mass and a relative integrity of form density of however one in the outer jelly like barrier. The air at bay through the swollen compound buoyancy to the cutting-edge indefinite amount paperwork. The most generally used excipient is non-effervescent floating drug shipping gadget vicinity unit gel forming or extremely swells able polysaccharide kind polysaccharides hydrocolloids, and matrix forming polymers like polyacrylate, polymethacrylate and polycarbonate.^[11]

(A) Hallow Microspheres

The usage of a unique emulsion- solvent diffusion procedure, hollow microspheres, or microballons, were produced and then loaded with ibuprofen inside their outer polymer shells. An agitated aqueous answer of PVA that was thermally regulated at 40°C was full of the drugs ethanol: dichloromethane answer alongside an enteric acrylic polymer. The fuel section that bureaucracy inside the internal cavity of polymer microspheres containing drugs is produced in scattered polymer droplets via the evaporation of dichloromethane. For greater than 12 hours in vitro, the microballons floated continuously at the floor of surfactant-containing acidic dissolving media.

(B) Colloidal gel barrier systems (hydrodynamic balanced system).

This system makes bigger gastric retention time and maximizes the amount of drug that reaches its absorption internet site on line in the answer shape. It necessarily includes drug with gel –forming hydrocolloids to stay buoyant at the belly content material. At the side of polycarbophil, polystyrene and polyacrylate. Upon contact with gastro intestinal fluid the hydrocolloid in the device hydrates to generate a colloid gel barrier to its surrounding.

(C)Inragastric / Micro porous compartment system:

The tool is made from a drug reservoir housed inside a micro porous chamber with pores on each the pinnacle and backside surfaces. To avoid any ability bodily touch between the dissolved medication and the belly walls, there savior compartment's outer edge walls have been tightly sealed. A unique levodopa gastro-retentive dosage form with enlarged dimensions and first rate stiffness is based on unfolding polymeric membranes. The gelatin changed into folded into massive pills. Inside 15 min. of injection, in step



with in vitro research, the unfolded country changed into reached, and this became proven in vivo in beagle dogs. At the least hours had been spent keeping the opened-up form. It became decided that This dose shape would possibly beautify the treatment of many medications with narrow absorption windows. nonetheless, there is a danger that the polymeric movies turn into lodged within the esophagus, resulting in severe discomfort for the affected person or remedyassociated complications, and prolonged use of the stiff dose form could reason stomach blockage.

(D) Alginate beads

The development of multi-unit floating dosage forms began with spherical calcium alginate beads that were approximately 2.5 mm in diameter and can be fabricated by means of including sodium alginate answer into aqueous answer of calcium chloride, ensuing within the precipitation of calcium alginate, the beads are similarly separated, snap – frozen in liquid nitrogen and freeze – dried at four 100°c for 24 hrs. Results in era of amorous gadget. This fabricated machine might hold a floating force for over 12hrs and these floating beads provide a longer residence time of extra than 5.five hrs.

3. Raft- forming systems

Raft – forming gadget are in an awful lot interest for the transport of antacid and drug delivery for gastro contamination and disorders. On touch with gastric fluid, a gel – forming solution swells and paperwork a viscous of gastric fluid hence centers release drug slowly within the belly.

ADVANTAGE OF FDDS

- 1. Simple and traditional method for components.
- 2. Website online-particular drug shipping.

- 3. Managed delivery of medicine.
- 4. Progressed drug absorption with elevated GRT and excess period of touch of dosage regime at its target site.
- 5. Minimizing irritation of GIT mucosa via the medication with sluggish release rate. Acidic drug substance like aspirin cause infection to gastric mucosa it comes in touch. For this reason, HBS method might be useful in management of aspirin and other comparable tablets.
- 6. In treating gastro esophageal reflux issues (GERD).
- 7. Ease of management with higher patient compliance.
- 8. The floating drug transport device also contains sure risks which restriction its applicability. ^[3]

DISADVANTAGE OF FDDS

- 1. The principal disadvantage of a floating system is due to the need of an enough level of gastric fluids to glide without a sink. But, this problem can be overcome by way of coating the dosage shape with bio adhesive polymers that easily adhere to gastric mucosa.
- 2. The medicine the ones get significantly absorbed at some point of gastrointestinal tract, with big first-bypass metabolism, are applicable candidate predominantly.
- **3.** Gastric emptying of floating structures may also occur at random and relatively depending on its dimensions. Therefore patients should not have dosage previous going to mattress.

2. Physiological Concerns

One of kind physiological factors which consist of pH, gastric enzymes, nature and amount of gastric secretions, residence time, and effective absorbing floor location on the website of delivery make a



contribution the main characteristic in drug execution and absorption. The gastric pH frequently impacts the general performance of orally administered drug and it is influenced with the useful resource of different factors like weight loss plan, disease, the presence of gases, fatty acids and other fermentation merchandise within the belly. Radio telemetry has been efficaciously utilized in measuring the gastrointestinal pH in a person. The suggested suggest price of gastric pH in fasted wholesome topics is 1.1±0.15, and the advice gastric pH in fed kingdom in healthful men has been stated to be 3.6±0.4. This pH returns to the basal degree in about 2 to 4 h. Age is the second one trouble and pathological conditions which impact gastric pH. Approximately 20% of the people show off each elderly dwindled (hypochlorhydria) or no gastric acid secretion (achlorhydria) leading to basal pH rate over 5.0. Pernicious anemia and AIDS are the syndromes wherein there can be considerably reduction in gastric acid secretion main to accelerated gastric pH. Management of drugs like H2 receptor antagonist and proton pump inhibitors drastically lessen gastric acid secretion. The advocate pH price in fasted duodenum has been stated to be 5.8t±0.3in healthful topics, and the fasted small intestine pH is noted to be 6.0±0.14. Regular gastric time usually degrees among 5 min to 2 h. In consideration, fasted and fed situation of the belly, splendid forms of gastrointestinal motility and secretions were studied. In a fasted nation the electrical pastime of the gastrointestinal tract is evidenced thru some cyclic contractile sports, within the scientific language, its miles known as migrating myoelectric complexes (MMC).^[5]

3. Criteria Selection of Drug Candidate for the Floating Drug Shipping Gadget

1. Absolutely absorption through better gastrointestinal tract.

- 2. Capsules with low pKa, that does show off unionized characters
- 3. Tablets are possessing decrease solubility at better pH.
- 4. Impact of neighborhood movement of medicine e. g. treating Helicobacter pylori in remedy of ulcerative situations.
- 5. Drugs which get degraded in alkaline pH situations; bioavailability of those may be extra appropriate by using way of fabricating into gastro- retentive bureaucracy.
- 6. Minimizing gastric irritation as it can bring about the boom of drug awareness stage in the stomach^{[6][7]}

4. Boundaries of floating drug shipping system

- 1. FDDS need to be administered after the meal however the house and emptying time of drug relies upon the digestive country which affects its absorption.
- 2. Floating ability depends on the hydration kingdom of the dosage shape. Its miles vital of management of water intermittent (a tumbler complete, each 2h) to maintain these pills floating in vivo.
- 3. Floating potential of drug within the belly relies upon upon the man or woman being placed.
- 4. Pills with solubility or balance problem with the gastric fluids are not an appropriate candidate for FDDS. ^{[4] [6] [7]}
- 5. Positive drugs though readily get absorbed inside the belly with a hit first skip metabolism are not appropriate as slow gastric emptying may additionally cause the reduced systemic bio-availability.

5. Application of Floating Drug Shipping Gadget

1. FDDS are claimed for the extended efficacy of drugs as recent research show that the

management of Diltiazem floating capsules twice an afternoon could be greater powerful compared to ordinary pills in hypertensive sufferers.

- 2. In case of Parkinson affected person, FDDS is powerful in absorption of the drug over a period of 6-8 h and maintained full-size plasma awareness.
- 3. FDDS is website online precise drug delivery: those systems are especially fantastic for tablets which might be especially absorbed from the stomach or the proximal part of the small gut, e .g Riboflavin and Furosemide.
- 4. FDDS served as a super drug transport system in the eradication of Helicobacter pylori, blamed for chromic gastritis and peptic ulcers.
- 5. FDDS are ideal HBS dosage form to provide higher shipping of medication and reduced its GI aspect results. ^{[6] [8]}

6. Mechanism of Floating System

So that you can prolong the retention length, numerous strategies had been attempted, inclusive of maintaining the dosage shape inside the belly. Floating dosage forms (gas-producing and swelling/expanding systems). mucoadhesive systems, excessive-density systems, in particular formed systems, gastric-emptying delaying gadgets, and co-management of gastric-emptying delaying medications are a number of the tasks made in this regard. The floating dosage forms are the maximum extensively utilized of these. Due to the fact floating drug transport systems have a lower bulk density than gastric fluids; they glide in the stomach for prolonged intervals of time without slowing down the fee at which the stomach empties .The drug is removed from the gadget steadily at the right fee even as it is floating on the stomach contents. The drug's residual gadget is eliminated from the stomach following its launch. As a end result, the variations in plasma

drug attention are higher managed and the GRT is raised. To preserve the buoyancy of the dosage shape at the meal's floor, but, a minimal level of floating pressure (F) is also necessary similarly to the minimum stomach content material necessary to permit the correct fulfillment of the buoyancy retention effect. a unique equipment for figuring out the ensuing weight has been disclosed within the literature as a way to measure the kinetics of the floating force. The device works with the aid of always measuring the pressure (as a characteristic of time) same to F had to hold an object submerged. If F is at the upper high-quality facet, the item will float greater without problems. This device aids in FDDS optimization in phrases of sustainability and balance of floating forces generated to avoid any unexpected fluctuations in intragastric buoyancy.

F = Fbuoyancy - Fgravity = (Df - Ds) g v

Where, F= total vertical force, Df = fluid density, Ds = object density, v = volume.

CONCULSION

Floating Drug Delivery Systems (FDDS) offer an effective strategy to improve the bioavailability and controlled release of drugs, particularly those targeting the stomach or upper gastrointestinal tract. By maintaining buoyancy and prolonging gastric residence time, FDDS help optimize therapeutic outcomes and minimize dosing frequency. Continued innovations in polymer science, formulation techniques, and in vivo evaluation methods are expected to further advance the development and clinical success of floating drug delivery systems.

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