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A REVIEW ON FLOTING DRUG DELIVERY SYSTEMS

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Abstract:
The Main aim of this review on floating drug delivery systems (FDDS) was to compile the recent literature with special focus on the principal mechanism of floatation to achieve gastric retention. The recent developments of FDDS including the drugs available and marketed products and formulation variables affecting gastric retention, approaches to design single-unit and multiple-unit floating systems, and their classification and advantages and disadvantages of floating drug delivery.The various factors influencing floating drug delivery This review also summarizes the approaches and application of floating systems, and applications of these systems. These systems are useful to several problems encountered during the development of a pharmaceutical dosage form.

Keywords: *floating drug delivery systems, controlled drug delivery and Gastric retention.*

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1.1 INTRODUCTION:

Gastroretentive dosage forms (GRDFs) are prepared to be retained in the stomach for a prolonged time and release their active medicaments and thereby enable sustained and prolonged input of the drug to the upper part of the gastrointestinal (GI) tract [1].Gastric retention improves bioavailability, reduces drug loss and improves solubility for drugs which are poor soluble in a high pH environment. It has applications also for local drug delivery to the stomach and small intestines. Gastro retention helps to provide better availability of new products with new therapeutic possibilities and substantial benefits for patients [2].

Drugs that are required to be formulated into gastroretentive dosage forms include:

1. Drugs acting locally in the stomach.
2. Drugs that are absorbed in the stomach.
3. Drugs which are poorly soluble at alkaline p^H.
4. Drugs with a narrow therapeutic window
5. Drugs rapidly absorbed from the GI tract and
6. Drugs that degrade in the colon [3].

It is evident from the recent scientific and patient literature that an increased interest in novel dosage forms that are retained in stomach for a prolonged and predictable period of time exists today in academic and industrial research groups. One of the most feasible approaches for achieving a prolonged and predictable drug delivery in the GI tract is to control the gastric residence time (GRT), i.e. gastro retentive dosage form (GRDFs).

GRDFs extend significantly the period of time over which the drugs may be released. They not only prolong dosing intervals, but also increase patient compliance beyond the level of existing controlled release dosage form.

1.2 REQUIREMENTS FOR GASTRO RETENTION

To achieve gastro retention, the dosage form must satisfy some requirements. One of the key issues is that the dosage form must be able to withstand the pressure caused by peristaltic waves in the stomach and constant grinding and churning mechanisms. It must resist premature gastric emptying and once the purpose has been served, it should be removed from the stomach with ease

1.3 APPROACHES TO GASTRIC RETENTION[4,5]

Various approaches include: I.Floating systems, II. Bio adhesive systems, III. Swelling and expanding systems, IV. High density systems, VI. Modified system

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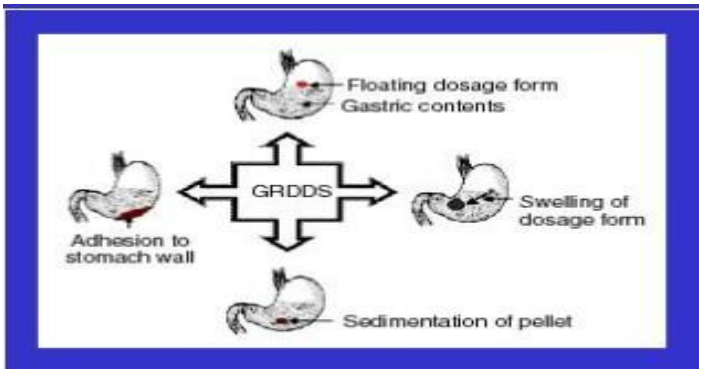


Fig1: Classification of gastro retentive drug delivery system

I. Buoyant/ Floating Systems:

Floating Drug Delivery Systems [6] (FDDS) have a bulk density lower than gastric fluids and thus remain buoyant in the stomach for a prolonged period of time, without affecting the gastric emptying rate

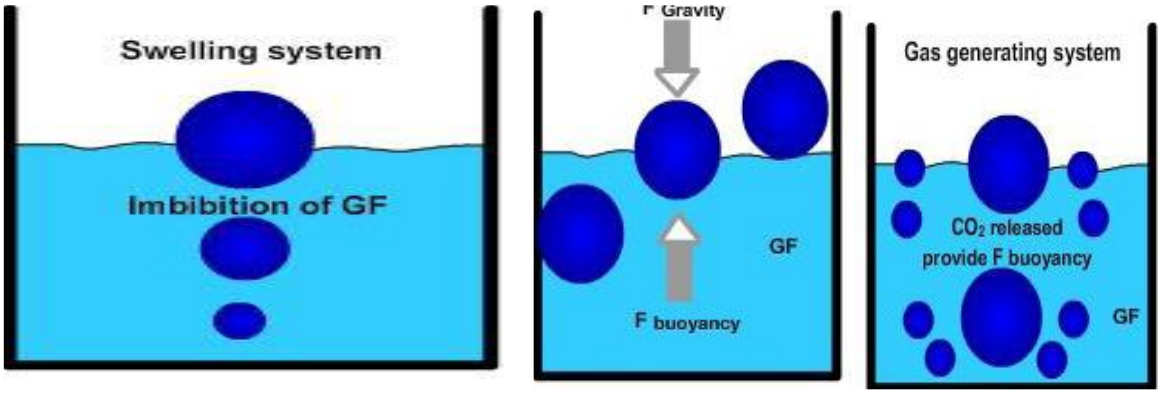


Fig 2: Mechanism of floating system

2. Bio/Muco-adhesive Systems [7]:

Bio/muco-adhesive systems are those which bind to the gastric epithelial cell surface or mucin and serve as a potential means of extending the GRT of drug delivery system in the stomach, by increasing the intimacy and duration of contact of drug with the biological membrane**.**

3. Swelling and Expanding Systems [8]

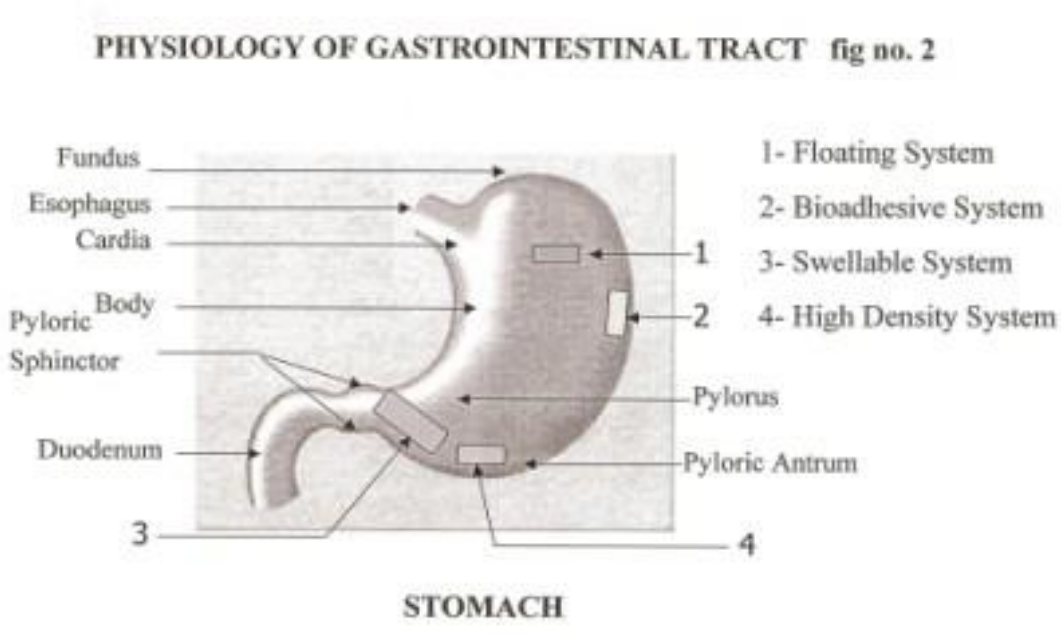
These are the dosage forms, which after swallowing; swell to an extent that prevents their exit from the pylorus. As a result, the dosage form is retained in the stomach for a long period of time. These systems may be named as "*plug type system*", since they exhibit the tendency to remain logged at the pyloric sphincter if that exceed a diameter of approximately 12-18 mm in their expanded state. The formulation is designed for gastric retention and controlled delivery of the drug into the gastric cavity

4. High Density Systems [9]:

These systems with a density of about 3 g/cm^3 are retained in the rugae of the stomach and are capable of withstanding its peristaltic movements. A density of 2.6-2.8 g/cm^3 acts as a threshold value after which such systems can be retained in the lower part of the stomach. High-density formulations include coated pellets

5. Incorporation of Passage Delaying Food Agents [10]:

Food excipients like fatty acids e.g. salts of myristic acid change and modify the pattern of the stomach to a fed state, thereby decreasing gastric emptying rate .



1.4 TYPES OF FLOATING DRUG DELIVERY SYSTEMS (FDDS) [11,12]

Based on buoyancy mechanism, two different technologies have been utilized in development of FDDS which are:

1. Effervescent System, and
2. Non- Effervescent System

1. EFFERVESCENT SYSTEM:-

Effervescent systems include use of gas generating agents, carbonates (ex. Sodium bicarbonate) and other organic acid (e.g. citric acid and tartaric acid) present in the formulation to produce carbon dioxide (CO_2) gas, thus reducing the density of the system and making it float on the gastric fluid

These effervescent systems further classified into two types.

I Gas Generating systems

II Volatile Liquid/Vacuum Containing Systems

I. Gas generating systems

Gas generating systems includes various types

1. Intra gastric single layer floating tablets
2. Intra gastric bi layer floating tablets
3. Multiple unit type floating pills

II Volatile Liquid/Vacuum Containing Systems

It includes

1. Intra gastric floating gastrointestinal drug delivery systems
2. Inflatable gastrointestinal delivery systems
3. Intra gastric osmotically controlled drug delivery systems

1. NON EFERVESCENT SYSTEMS

The Non-effervescent FDDS based on mechanism of swelling of polymer or bioadhesion to mucosal layer in GI tract. The most commonly used excipients in non-effervescent FDDS are gel forming or highly swellable cellulose type hydrocolloids, polysaccharides and matrix forming material such as Polycarbonate, Polyacrylate, Polymethacrylate, polystyrene as well as bioadhesive polymer such as Chitosan and Carbopol. The various types of this system are as:

1. Single layer floating tablets
2. Bilayer floating tablets
3. Alginate beads
4. Hollow Microspheres

Gasric retention time (GRT) influenced by several actors

1. Density of dosage form 2. Size of the dosage form 3.Shape of the dosage form 4.Diet 5.Nature of meal 6. Caloric content 7.Gender 8.Age 9.Posture and other factors like body mass index (BMI).

1.5 Advantages of FDDS [13,14]

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

1. Improved drug absorption, because of increased GRT and more time spent by the dosage form at its absorption site.
2. Controlled delivery of drugs.
3. Delivery of drugs for local action in the stomach.
4. Minimizing the mucosal irritation due to drugs, by drug releasing slowly at controlled rate.
5. Treatment of gastrointestinal disorders such as gastro-esophageal reflux.
6. Simple and conventional equipment for manufacture.
7. Ease of administration and better patient compliance.

1.6 Disadvantages of FDDS [15]

1. 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.
2. Drugs that cause irritation and lesion to gastric mucosa are not suitable to be formulated as floating drug delivery systems.
3. High variability in gastric emptying time due to its all or non-emptying process.

Gastric emptying of floating forms in supine subjects may occur at random and becomes highly dependent on the diametral size.

1.7 List of few drugs –FDDS [17]

S.No	Dosage forms	Drugs
1	Powders	Few Basic drugs
2	Granules	Diclofenac,Indomethacin
3	Tablets	Verpamil,quinine gluconate,Flououracil,Atenolol,Isosorbide,Aetylsalicylic acid,PABA.
4	Capsules	Furosemide,L-dopa,Misoprostol,Propranolol,
5	Films	Cinnarizine
6	Microsphers	Aspirin,Ibuproen,Grisiofulvin.

1.8 Marketed products of FDDS [18]

S.No	Brand name	Drug	Dose	Company
1.	Liquid Gavison	Aluminium Hydroxide Magnesium carbonate	95 mg 358 mg	Glaxosmith kline,India
2.	Cifran OD	Ciproflaxacin	1 gm	Ranbaxy ,India
3.	Conviron	Ferrous sulphate	500 mg	Ranbaxy ,India
4.	Cytotec	Misoprostol	100mcg	Pharmacia,USA
5	Modapar	Levodopa,Benserazide	100,25 mg	Roche products,USA
6.	Topalkan	Al-Mg antacid	500 mg	Pirre Fabre drug,France
7.	Valrelease	Diazepam	15 mg	Hofmann-LaRoche,USA

1.9 CONCLUSION:

Floating drug delivery system provides retention drug in GIT for Drug absorption is a highly variable procedure and prolonging gastric retention of the dosage form extends the time for drug absorption. FDDS promises to be a potential approach for gastric retention. Although there are number of difficulties to be worked out to achieve prolonged gastric retention, a large number of companies are focusing toward commercializing this technique

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