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A Review Article On Gastroretentive Floating Drug Delivery System

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Abstract : The oral dirrection debris the more attractive , widely accepted approach for drug administration owed to his convenience, non-invasiveness, and cost-effectiveness. To beaten those objection, Gastroretentive Drug Delivery Systems (GRDDS) have been matured.

Among those various gastroretentive approaches, the Floating Drug Delivery System (FDDS) stands out as a result of unique mechanism that allows dosage forms to continue buoyant on gastric fluid as | an continued period beyond touching the rate of gastric emptying..

This project focuses on the design, formation, and assesment of a gastroretentive floating drug delivery system as a model drug with poor bioavailability in conventional oral formulations. The formulation strategy involves the use of the two effervescent and non-effervescent techniques,along with gas-reproducing cadre like sodium bicarbonate and citric acid to facilitate buoyancy. The prepared formulations were evaluated for key pharmaceutical parameters, including pre- and post-compression characteristics.

IndexTerms - Gastroretentive Drug Delivery System (GRDDS), Floating Drug Delivery

System (FDDS), Gastric retention, Buoyancy, Sustained release, Controlled drug delivery

1.Introduction

INTRODUCTION

Gastroretentive Floating Drug Delivery Systems are make to delay the gastric residence time (GRT) of quantity forms, thereby enhancing drug absorption in the upper GIT

accounting for over 60% of all pharmaceutical dosage forms in the global market. However, despite these advantages, current oral drug delivery systems has several outcomes that can negatively affect therapeutic efficacy, particularly in the case of drugs with poor absorption in the lower gastrointestinal tract (GIT).

The human gastrointestinal tract is a complex system where physiological variables .Absorption and bioavailability of orally administered drugs. One major drawback of traditional oral dosage forms is their short gastric residence time.

To overcome these challenges, novel drug delivery strategies has made, among which Gastroretentive Drug Delivery Systems (GRDDS) had do a good approach .

Among the various GRDDS approaches, such as bioadhesive systems, swelling structure, high-density structure, and magnetic structure, the Floating Drug Delivery System (FDDS) is the most widely explored and successful. FDDS operate on the principle of buoyancy. These systems are designed to has a less volume than gastric fluids and, therefore.

Floating systems can be classified into effervescent and non-effervescent systems. Effervescent structures typically contain gas-forming things such as sodium bicarbonate.
leading to buoyancy. Non-effervescent systems, on the other hand, rely on swellable polymers that, upon hydration, form a gel-like structure of lower density than gastric fluid and achieve floating without gas generation.

The success of FDDS depends on multiple formulation and physiological factors, including the selection of appropriate polymers, control of, duration of buoyancy, behavior, kinetics, and compatibility with the gastric environment. These factors must be carefully optimized to make a maintainence both the extended gastric residence and desired drug release profiles.

2. AIM OF THE STUDY

GFDDS that can effectively enhance the gastric time , sustain the release of a model drug, thereby improving its accuracy and therapeutic efficacy.

Many drugs exhibit poor absorption profiles in the lower gastrointestinal tract and are characterized by short biological half-lives, pH-dependent solubility, or degradation in the intestinal environment. These factors collectively contribute to low oral , reduced efficacy, and the need for frequent dosing.

- Providing good strength and sustained removal of the drug,
- Minimizing fluctuations in plasma drug levels,
- low the frequency of drug providing, and
- Enhancing overall bioavailability and patient compliance.

To achieve this, the study involves the selection and incorporation of suitable hydrophilic and Carbopol.

Additionally, the aims to:

- Evaluate physicochemical properties of the prepared dosage forms through standard pharmacopeial tests.

3. RATIONALE BEHIND FLOATING DRUG DELIVERY SYSTEM

The making and forming of advanced oral drug delivery systems are primarily driven, especially for drugs that show poor absorption or low in the lower gastrointestinal tract
(GIT). Among the various site-specific drug delivery systems, Floating

3.1 Physiological Basis for Gastroretention

The human stomach serves as a critical site for the dissolution and partial absorption of many drugs:

- Gastric motility patterns
- Volume and nature of the gastric contents (fasted vs. fed state),
- Physical and chemical properties of the dosage form (density, size, and shape),
- Individual physiological variations (age, gender, health condition)
- Mixing primarily in the upper GIT, such as levodopa or riboflavin,
- low mixing at intestinal pH, such as diazepam,

3.2 Approach and Allowances of Floating Drug Delivery Systems

Key advantages of FDDS include:

- Prolonged gastric residence time, which enhances drug absorption
- lower dosing frequency, due to sustained and controlled drug release.
- Targeted local therapy, especially for drugs used to treat gastric infections, ulcers, or inflammation.
- Reduced drug wastage due to better absorption and utilization.
- Lower fluctuation in plasma drug concentration, thereby minimizing side effects and improving therapeutic outcomes.

3.3 Suitability of Drugs for Floating Drug Delivery

Not all drugs are suitable candidates for FDDS. Drugs that are best suited for floating systems typically have the following characteristics:

- Solubility in acidic pH (gastric pH),
- Instability in alkaline pH of the intestine,
- Low dose requirement (to ensure a compact dosage form can float).

*Some examples of drugs that benefit from FDDS include:

- Ciprofloxacin
- Amoxicillin
- Metronidazole
- Domperidone
- Verapamil
- Furosemide • Propranolol

3.4 Technological Significance

From a pharmaceutical technology perspective, floating systems are relatively easier to develop compared to other GRDDS like mucoadhesive systems or expandable systems. They can be fabricated using commonly available excipients and processed via conventional manufacturing techniques such as direct compression, wet granulation, or melt granulation.

3.5 Challenges and Considerations

Despite the clear advantages, there are also challenges associated with floating drug delivery:

- The requirement of sufficient gastric fluid for hydration and floatation,
- Risk of dose dumping if the system fails to float or disintegrates prematurely,
- Patient-related variability (e.g., posture, age, disease conditions) affecting system performance.

1. TYPES OF FLOATING DRUG DELIVERY SYSTEMS

a) Effervescent Floating structures

b) Non-Effervescent Floating Systems

c) Raft-Forming Systems

2. Materials and Methods

2.1 Materials

- Model drug: e.g., Ciprofloxacin Hydrochloride
- Polymers: Hydroxypropyl Methylcellulose (HPMC), Sodium alginate, Carbopol □ Solvents: Distilled water, ethanol

6.2 Method of Preparation

Direct Compression Method (for tablets) :

1. Weigh all ingredients accurately.
2. Compress the mixture using a tablet punching machine.
3. Results and Discussion :

The results obtained from the formation , evaluation, and in study character of the gastroretentive floating drug delivery system (FDDS) are discussed in detail below. evaluated for their pharmaceutical quality, buoyancy behavior, swelling capacity, and drug release characteristics. The discussion of these parameters helps in understanding the overall performance and efficiency of the floating tablets .

7.2Post-Compression Parameters

The prepared floating tablets were subjected to standard post-compression tests:

- Tablet hardness ranged from 4.5 to 6.0 kg/cm^2, indicating adequate mechanical strength to withstand handling and packaging.
- Friability was found to be less than 1%, which is within the acceptable limit as per pharmacopeial standards, confirming good durability.
- Weight variation was within ±5%, and drug content uniformity ranged between 98% and 102%, which complies with pharmacopeial requirements and ensures dose accuracy in each unit.

7.3Floating Behavior (Buoyancy Studies)

- FLT: Most formulations exhibited an FLT of less than 1 minute, indicating a quick onset of floating.
- TFT: Depending on the formulation, tablets floated for a period ranging from 8 to more than 12 hours.

Formulations containing higher concentrations of sodium bicarbonate and swellable polymers like HPMC K15M showed longer floating duration due to enhanced gas entrapment and matrix stability. The combination of effervescent and swellable components was critical to achieving both rapid floatation and sustained buoyancy.

7.4 Swelling Index

The swelling behavior of the tablets was monitored at regular intervals by measuring the increase in tablet weight after immersion in the dissolution medium:

- The swelling index increased gradually over time and stabilized after 6–8 hours.
- Formulations with many amounts of hydrophilic polymers such as and sodium alginate exhibited greater swelling, which also contributed to sustained drug release.

Swelling plays a dual role in FDDS: maintaining matrix integrity for sustained release and contributing to the buoyancy by reducing tablet density.

7.5In Vitro Drug Release Studies

□ Formulations with higher polymer content showed slower and more sustained drug release, while those with lower
polymer content released the drug more rapidly.

CONCLUSION

The making of Gastroretentive Floating Drug Delivery Systems (FDDS) has proven be an effective strategy for overcoming several limitations associated with conventional oral drug formulations. Through the design and formulation of floating tablets for a model drug, we successfully demonstrated the potential of FDDS

The future of FDDS holds promise not only for enhancing the delivery of conventional drugs but also for facilitating the targeted delivery of biologics, peptides, and vaccines.

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