2026 Volume: 02 Issue: 06 www.ijrpa.com ISSN 2456-9995 Review Article

International Journal Research Publication Analysis

Page: 01-07

# GASTRORETENTIVE DRUG DELIVERY SYSTEMS (GRDDS): A REVIEW

**Nandan Kumar*[1], Nidhi Saxena[2], Nilesh Jain[3], and R.B. Goswami**

[1]Sagar institute of Research Technology & Science – Pharmacy, Bhopal, Madhya Pradesh, India.

[2]Associate Professor, Department of Pharmacognosy, Sagar Institute of Research Technology & Science- Pharmacy, Bhopal, Madhya Pradesh, India.

[3]Professor- Department of Pharmaceutical Chemistry, Sagar Institute of Research Technology & Science – Pharmacy, Bhopal, Madhya Pradesh, India

[4]Professor, Department of Pharmacognosy, Sagar Institute of Research Technology & Science- Pharmacy, Bhopal, Madhya Pradesh, India.

**Article Received: 13 May 2026**
**Article Revised: 03 June 2026**
**Published on: 23 June 2026**

***Corresponding Author: Nandan Kumar**
Sagar institute of Research Technology & Science – Pharmacy, Bhopal, Madhya Pradesh, India.

DOI: https://doi-doi.org/101555/ijrpa.2397

## ABSTRACT

Gastroretentive Drug Delivery Systems (GRDDS) are oral controlled drug delivery systems designed to prolong the gastric residence time (GRT) of dosage forms. These systems are particularly beneficial for drugs that exhibit a narrow absorption window in the upper gastrointestinal tract, are unstable at intestinal pH, or act locally in the stomach. GRDDS enhances bioavailability, reduces dosing frequency, and improves therapeutic outcomes.

Various approaches such as floating systems, bioadhesive systems, swelling systems, expandable systems, and high-density systems have been developed to achieve prolonged gastric retention. This review discusses the physiology of the stomach, need for GRDDS, formulation strategies, evaluation parameters, advantages, limitations, and future prospects.

**KEYWORDS:** Gastroretentive systems, floating drug delivery, gastric residence time, bioadhesive systems, controlled release.

## 1. INTRODUCTION

Oral drug delivery is the most widely accepted route of administration due to convenience andpatientcompliance.However,conventionaldosageformsoftensufferfromshortgastric residence time and unpredictable gastric emptying, leading to reduced bioavailability of certain drugs [1].

GastroretentiveDrugDeliverySystems(GRDDS)aredesignedtoremaininthestomachfor aprolongedperiod,therebyenhancingdrugabsorptionintheuppergastrointestinaltract[2]. These systems are particularly useful for drugs absorbed primarily from the stomach or proximal small intestine.

## 2. Physiology of the Stomach and Gastric Emptying

Thestomachconsistsoffundus,body,antrum,andpylorus.Gastricemptyingoccursthrough coordinated motility patterns known as the Migrating Myoelectric Complex (MMC), which occurs every 90–120 minutes during fasting [3].

Thestomachconsistsoffundus,body,antrum,andpylorus.Gastricemptyingoccursthrough coordinated motility patterns known as the Migrating Myoelectric Complex (MMC), which occurs every 90–120 minutes during fasting [3].

Factorsaffectinggastricretention include

- Densityofdosageform
- Sizeandshape
- Fedorfasting state
- Natureofgastricmotility

UnderstandingthesefactorsisessentialfordesigningeffectiveGRDDS[4].

## 3. NeedforGastroretentiveDrugDeliverySystems

GRDDSissuitablefordrugsthat:

- Haveanarrowabsorptionwindow
- ArepoorlysolubleatalkalinepH
- Actlocallyinthestomach
- Undergorapidintestinalmetabolism

Examples include:

- Merformin
- Levodopa
- Ranitidine

Thesedrugsshowimprovedbioavailabilitywhenretainedinthestomachforextended periods [5].

## 4. Approaches of GRDDS

### 4.1 Floating Drug Delivery Systems(FDDS)

Floatingsystemshaveadensitylowerthangastricfluid,enablingthemtofloatonstomach contents [6].

Types:

- Effervescentsystems(gas-generatingagentssuchassodium bicarbonate)
- Non-effervescentsystems(hydrophilicpolymerslike HPMC)

Thesesystemsprolonggastricretentionandprovidesustaineddrugrelease.

### 4.2 Bioadhesive(Mucoadhesive)Systems

ThesesystemsadheretothegastricmucosausingpolymerssuchasCarbopolandchitosan, thereby prolonging residence time [7].

### 4.3 SwellingandExpandingSystems

Thesedosageformsswellafterabsorbinggastricfluid,increasinginsizetopreventpassage through the pylorus [8].

### 4.4 High-DensitySystems

Thesesystemspossessadensitygreaterthangastriccontentsandsinktothebottomofthe stomach, thereby increasing retention [9].

### 4.5 Raft-FormingSystems

Raft-formingsystemscreateaviscousgelthatfloatsongastriccontentsandarecommonly used in GERD treatment [10].

## 5. FormulationConsiderations

ImportantfactorsinGRDDSformulationinclude:

- Drugsolubilityand stabilityinacidicpH
- Polymerselection(HPMC,sodiumalginate,polyethylene oxide)
- Dosageformsize(>7.5mm preferred)
- Gastricmotility conditions

Carefuloptimizationensurescontrolleddrugreleaseandprolongedretention.

## 6. EvaluationParameters

GRDDSareevaluatedby:

- Floatinglagtime
- Totalfloatingduration
- Swellingindex
- In-vitro dissolution studies
- In-vivoimagingtechniques(X-ray,gamma scintigraphy)

Theseparametersensureeffectivenessandreproducibility[4].

## 7. Advantages

- Improvedbioavailability
- Reduceddosing frequency
- Enhancedtherapeuticefficacy
- Betterpatient compliance
- Reducedplasmalevel fluctuations

## 8. Limitations

- NotsuitablefordrugsunstableinacidicpH
- Notappropriatefordrugscausinggastric irritation
- Variabilityduetogastricmotility
- Limitedapplicabilityforhigh-dose drugs

## 9. FuturePerspectives

Advancesinpolymerscience,nanotechnology,and3Dprintingareenablingdevelopmentof smart gastroretentive systems. Combination strategies such as floating–bioadhesive systems may further improve gastric retention and therapeutic outcomes.

## CONCLUSION

Gastroretentive Drug Delivery Systems provide an effective approach to enhance the bioavailabilityofdrugswithnarrowabsorptionwindowsintheuppergastrointestinaltract. Various techniques including floating, mucoadhesive, swelling, and high-density systems have been successfully developed. Despite certain limitations, GRDDS holds significant promise in modern pharmaceutical research and development.

## REFERENCES


1. BankerGS,RhodesCT.ModernPharmaceutics.4thed.NewYork:MarcelDekker; 2002.
2. StreubelA,SiepmannJ,BodmeierR.Gastroretentivedrugdeliverysystems.Expert Opin Drug Deliv. 2006;3(2):217–233.
3. WilsonCG,WashingtonN. Thestomach:itsroleinoraldrugdelivery. In:
4. PhysiologicalPharmaceutics.2nded. 1989.
5. Deshpande AA, Shah NH, Rhodes CT, Malick W. Development of a novel controlled-releasesystemforgastricretention.PharmRes.1997;14(6):815–819.
6. RougeN,etal.Comparativepharmacokineticstudyoffloatingdosageform.IntJ Pharm. 1998;168:165–175.
7. SinghBN,KimKH.Floatingdrugdeliverysystems:anapproachtooral controlled
8. drugdelivery.JControlRelease.2000;63:235–259.
9. ChienYW.NovelDrugDeliverySystems.2nded.NewYork:MarcelDekker;1992.
10. UrquhartJ,TheeuwesF.Drugdeliverysystemcomprisingareservoir.USPatent; 1975.
11. BechgaardH,LadefogedK.DistributionofpelletsintheGItract.J Pharm
12. Pharmacol.1978;30:690–692.
13. WashingtonN.Antacidsandraft-formingsystems.PharmJ.1987;239:389–391.
14. Pandey A, Kumar G, Kothiyal P and Barshiliya Y. Review on current approches in gastroretentive drug delivery system. Asian Journal of Pharmacy and Medical Science. 2012; 2(4):60-77.
15. Vyas SP. Controlled drug delivery: Concept and Advances. Vallabh Prakashan. 2006;196-217.
16. . Joseph R. Controlled drug delivery fundamentals and application. Revised and Expanded Marcell. Dekker Inc. 2nd edition. New York, 2009.
17. Khosla R and Davis SS. The effect of tablet size on the gastric emptying of non-disintegrating tablets. International Journal of Pharmaceutics. 1990;69:R9- R11.
18. Deshpandae AA, Rhodes CT, Shah NH and Malick AW. Controlledrelease drug delivery

systems for prolonged gastric residence. An overview. Drug delivery Indian Pharmaceutics, 1996;22:531-539.

19. Abrahamsson B, Alpsten M, Hugosson M, Jonsson UE, Sundgren M, Svenheden A and Tolli J. Absorption, gastrointestinal transit, and tablet erosin of felodipine extended release (ER) tablets. Pharmaceutical Research.1993;10:709.
20. Oth M, Franz M, Timmermans J and Moes AJ. The bilayer floating capsule: A Stomach directed drug delivery IJRPC 2020, 10(1), 96-104 Sai Dividevara et al ISSN: 2231–2781 104 system for misoprostol. Pharmaceutical research.1992;9:298.
21. Hermansson G and Sivertsson R. Gender- related difference s in gastric emptying rate of solid meals, Digestive Diseases and sciences. 1996;41(10):1994-1998.
22. Kaus LC, Fell JT, Sharma H and Taylor DC. Gastric emptying and intestinal transit of non-disintegrating capsules- the influence of metaclopramide. International Journal of pharmaceutics.1984;22(1):99-103.
23. Arrora S, Ali J, Khar RK and Baboota S. Floating drug delivery system: A review. AAPSE Pharma Science Technology. 2005;6(3):372-390.
24. Chawla G, Gupta P and Bansal AK. Gastroretentive drug delivery system. In Jain NK. Editor. Progress in Controlled and novel drug delivery system CBS Publication and Distributors. New Delhi. 2004;76-97.
25. Clarke GM, Newton JM and Short MD. Gastrointestinal transit of pellets of differing size and density. International journal pharmaceutics. 1993;100(13):81-92.
26. Moes AJ. Gastric retention system for oral drug delivery. Business briefing. Pharmatech. 2003;157-159.
27. Misra SK. Gastrointestinal targetting drug delivery system: A Review. Journal of Pharmacy Research. 2011;4(8):2751- 2754.
28. Rao BP, Kottan NA, Snehith VH and Ramesh C. Development of gastroretentive drug delivery system of Cephalexin by using factorial design. ARE Pharmaceutical. 2009;50: 8.
29. Sheth PR and Tossounian J. The hydrodyanamically balanced system. A novel drug delivery system for oral use. Drug delivery Indian Pharmaceutics. 2010;3(1):819-833.
30. Prajapati VD, Jani GK, Khutliwala TA and Zala BS. Raft forming system - An upcoming approach of gastroretentive drug delivery system. Journal of Control Release. 2013;168: 151-165.
31. 28. Prinderre P, Sauzet C and Fuxen C. Advances in Gastro-retentive drugdelivery

systems. Expert Opin. Drug delivery. 2011;8:1189-1203.

32. Chen YC, Ho HO, Lee TY and Sheu MT. Physical Characterization and sustained release profiling of gastroretentive drug delivery systems with improved floating and swelling capabilities. International Journal of pharmaceutics. 2013;441:162-169