

**FORMULATION AND EVALUATION OF SUSTAINED RELEASE MATRIX TABLET
OF ONDANSETRON USING NATURAL POLYMERS: REVIEW****Jogendra Kushwah^{*1}, Abhishek Nagar²**¹Scholar, Career Point School of Pharmacy, Career Point University, Kota, Rajasthan.²Professor, Career Point School of Pharmacy, Career Point University, Kota, Rajasthan.***Corresponding Author: Jogendra Kushwah**

Scholar, Career Point School of Pharmacy, Career Point University, Kota, Rajasthan.

DOI: <https://doi.org/10.5281/zenodo.23031923>**How to cite this Article:** Jogendra Kushwah^{*1}, Abhishek Nagar². (2026). Formulation And Evaluation of Sustained Release Matrix Tablet of Ondansetron Using Natural Polymers: Review. European Journal of Pharmaceutical and Medical Research, 13(10), 124–128.

This work is licensed under Creative Commons Attribution 4.0 International license.

Article Received on 31/08/2026

Article Revised on 21/09/2026

Article Published on 01/10/2026

ABSTRACT

Ondansetron is a widely used antiemetic with a short half-life, requiring frequent dosing. Sustained release (SR) matrix tablets prepared using natural polymers offer an effective approach to prolong drug release, improve patient compliance, and maintain therapeutic drug levels. Natural polymers such as xanthan gum, guar gum, sodium alginate, gum acacia, and HPMC-based combinations are biodegradable, biocompatible, cost-effective, and environmentally friendly. Recent advances in natural polymer-based SR matrix tablets have focused on optimizing drug release, enhancing tablet stability, and improving bioavailability. This review highlights the formulation strategies, evaluation methods, advantages, and prospects of natural polymer-based sustained release matrix tablets of ondansetron, emphasizing their potential as safe and effective oral drug delivery systems.

1. INTRODUCTION

Drug delivery systems (DDS) are technologies, formulations, and devices designed to transport and release pharmaceutical compounds into the body safely. Their primary goal is to optimise a drug's efficacy and safety by strictly controlling its targeted location, release rate, and duration of action, thereby minimising side effects and enhancing patient compliance.

Modern drug delivery has evolved far beyond traditional pills and syrups. The field now encompasses a wide variety of advanced systems that can be categorized by how they work and their intended routes of administration:

1.1 Controlled and Sustained Release Systems

These technologies are designed to bypass the sudden spikes and drops in medication levels associated with conventional, immediate-release pills.

1.1.1 Sustained Release: Releases drugs continuously at a slow, controlled rate over a prolonged period.

1.1.2 Targeted Release: Uses biological molecules, polymers, or nanomaterials to deliver the drug strictly to a specific site in the body, such as directly to a tumor.

1.2 Common Types of Delivery Technologies

1.2.1 Nanoparticles and Liposomes: Microscopic, biocompatible carriers that encapsulate medications. They improve drug solubility, extend how long the drug circulates in the bloodstream, and are heavily utilized in ScienceDirect Nanocarrier Applications for targeted therapies.

1.2.2 Transdermal Patches: Devices applied to the skin that allow drugs to be absorbed systemically at a consistent rate, avoiding gastrointestinal degradation.

1.2.3 Long-Acting Injectables: Specialized formulations that allow a single dose of medication to remain active in the body for weeks or months, vastly improving patient adherence.

1.3 Key Benefits of Advanced DDS

1.3.1 Enhanced Bioavailability: Helps drugs dissolve and be absorbed better, maximizing the amount that reaches the site of action.

1.3.2 Toxicity Reduction: By localizing the drug to the exact problem area, healthy tissues are spared, resulting in fewer side effects.

1.3.3 Macromolecule Delivery: Protects fragile proteins, peptides, and nucleic acids (e.g., mRNA) from being destroyed by the body's natural enzymes before they can take effect.

2. Objectives of Sustained Release (SR) Matrix Tablets

The primary objectives of sustained-release matrix tablets are to deliver the drug at a predetermined rate over an extended period, thereby improving therapeutic efficacy, patient convenience, and treatment outcomes.

2.1 To maintain a constant therapeutic drug concentration in the bloodstream for a prolonged duration.

2.2 To reduce the frequency of drug administration, thereby improving patient compliance, especially in chronic diseases.

2.3 To prolong the duration of drug action by releasing the drug in a controlled and sustained manner.

2.4 To minimize fluctuations in plasma drug concentration, avoid the peaks and troughs associated with conventional dosage forms.

2.5 To improve the bioavailability of drugs by maintaining effective drug levels over an extended period (where applicable).

2.6 To reduce dose-related adverse effects by preventing sudden increases in plasma drug concentration.

2.7 To enhance patient convenience and adherence through once-daily or twice-daily dosing.

2.8 To improve therapeutic efficacy by maintaining drug concentrations within the therapeutic window for a longer period.

2.9 To reduce the total dose required in some cases by improving drug utilization efficiency.

2.10 To protect drugs from rapid degradation or metabolism by controlling their release rate.

2.11 To reduce gastrointestinal irritation caused by immediate release of certain drugs by gradually releasing the drug.

2.12 To provide a simple, cost-effective, and reproducible dosage form using suitable matrix-forming polymers (natural or synthetic).

3. Ondansetron: An Overview

Ondansetron is a selective 5-hydroxytryptamine-3 (5-HT₃) receptor antagonist widely used as an antiemetic to prevent and treat nausea and vomiting associated with chemotherapy, radiotherapy, surgery, and various gastrointestinal disorders. It was developed in the 1980s and revolutionized the management of chemotherapy-induced nausea and vomiting (CINV) by providing effective symptom control with fewer adverse effects than older antiemetics.

Ondansetron is listed among the World Health Organization (WHO) Essential Medicines due to its efficacy, safety, and clinical importance.

• Chemical Information

Parameter	Description
Generic Name	Ondansetron
IUPAC Name	(RS)-9-Methyl-3-[(2-methyl-1H-imidazol-1-yl) methyl]-2,3,4,9-tetrahydro-1H-carbazol-4-one
Molecular Formula	C ₁₈ H ₁₉ N ₃ O
Molecular Weight	293.36 g/mol
Drug Class	Selective 5-HT ₃ receptor antagonist
Dosage Forms	Tablets, orally disintegrating tablets, oral solution, injection
Routes of Administration	Oral, Intravenous (IV), Intramuscular (IM)

• Mechanism of Action

Ondansetron acts by selectively blocking 5-HT₃ receptors located:

- On vagal afferent nerve terminals in the gastrointestinal tract
- In the chemoreceptor trigger zone (CTZ)
- In the vomiting center of the brainstem

Chemotherapy and radiotherapy stimulate enterochromaffin cells in the small intestine to release

serotonin (5-HT), which activates 5-HT₃ receptors and initiates the vomiting reflex. By antagonizing these receptors, ondansetron prevents the transmission of emetic signals to the brain.

4. Natural Polymers Used in Sustained Release Matrix Tablets

Natural polymers have become increasingly important in the formulation of sustained release (SR) matrix tablets because they are biocompatible, biodegradable, non-

toxic, readily available, cost-effective, and environmentally friendly. They regulate drug release by swelling, gel formation, erosion, or diffusion, thereby

maintaining therapeutic drug concentrations for prolonged periods.

• Classification of Natural Polymers

4.1 Plant-Derived Polymers

These polymers are obtained from plant sources and are widely used due to their excellent swelling and gel-forming properties.

S.NO.	NATURAL POLYMER	SOURCE	ROLE IN SR MATRIX TABLETS
1.	Xanthan Gum	Xanthomonas campestris fermentation	Swelling, gel formation, sustained drug release
2.	Guar Gum	Cyamopsis tetragonoloba	Matrix former, release retardant
3.	Gum Acacia	Acacia senegal	Binder and release modifier
4.	Gum Tragacanth	Astragalus species	Hydrophilic matrix former
5.	Tamarind Seed Polysaccharide	Tamarind seeds	Swelling polymer, sustained release
6.	Pectin	Citrus peels, apple pomace	Controlled release matrix
7.	Aloe Vera Gel	Aloe barbadensis	Bioadhesive and release retardant
8.	Fenugreek Mucilage	Trigonella foenum-graecum	Matrix former
9.	Okra Mucilage	Abelmoschus esculentus	Swelling polymer
10.	Hibiscus Mucilage	Hibiscus rosa-sinensis	Natural release-retarding agent
11.	Isabgol Husk (Psyllium)	Plantago ovata	Gel-forming polymer
12.	Karaya Gum	Sterculia urens	High swelling matrix polymer

4.2 Marine-Derived Polymers

S.NO.	Polymer	Source	Application
1.	Sodium Alginate	Brown seaweed	Gel-forming sustained release matrix
2.	Carrageenan	Red algae	Controlled release formulations
3.	Agar	Red algae	Matrix former and gel former

4.3 Microbial Polymers

S.NO.	Polymer	Source	Application
1.	Xanthan Gum	Xanthomonas campestris	Hydrophilic matrix
2.	Gellan Gum	Sphingomonas elodea	Sustained release matrix
3.	Dextran	Leuconostoc species	Controlled release carrier
4.	Pullulan	Aureobasidium pullulans	Film former and matrix polymer

4.4 Animal-Derived Polymers

S.NO.	Polymer	Source	Application
1.	Chitosan	Chitin from crab/shrimp shells	Bioadhesive sustained release polymer
2.	Gelatin	Collagen	Matrix former and binder
3.	Collagen	Animal connective tissues	Controlled drug delivery
4.	Albumin	Egg or serum proteins	Drug carrier system

• Mechanism of Drug Release from Natural Polymer Matrices

Natural polymers control drug release through one or more mechanisms:

1. **Swelling:** Water penetrates the tablet causing the polymer to swell and form a gel barrier.
2. **Diffusion:** Drug molecules diffuse slowly through the hydrated gel layer.
3. **Erosion:** The polymer gradually erodes, releasing the entrapped drug.

4. **Combination Mechanism:** Most natural polymer matrices exhibit both diffusion and erosion-controlled release.

5. Mechanism of Drug Release

The **mechanism of drug release** describes how a drug is released from its dosage form and becomes available for absorption. The main mechanisms are:

5.1 Diffusion – Drug molecules move from the dosage form into the surrounding fluid through the polymer matrix due to a concentration gradient.

5.2 Dissolution – The drug or polymer dissolves in body fluids, allowing the drug to be released gradually.

5.3 Erosion – The polymer matrix slowly degrades or erodes, releasing the entrapped drug.

5.4 Swelling – Hydrophilic polymers absorb water, swell, and form a gel layer through which the drug diffuses.

5.5 Osmosis – Water enters the dosage form through a semipermeable membrane, creating pressure that pushes the drug out at a controlled rate.

6. Formulation Methods

The common methods used for pharmaceutical formulation, especially for tablets, include:

1. Direct Compression

- Drug and excipients are blended and compressed directly into tablets.
- Simple, economical, and suitable for moisture- and heat-sensitive drugs.

2. Wet Granulation

- Powders are mixed with a binder solution to form granules, dried, and compressed.
- Improves flowability, compressibility, and content uniformity.

3. Dry Granulation

- Powders are compacted without using liquid, then milled into granules and compressed.
- Suitable for moisture- and heat-sensitive drugs.

4. Melt Granulation

- A meltable binder is heated to form granules without using solvents.
- Eliminates the need for drying and improves drug release control.

5. Spray Drying

- Drug and excipients are dissolved or suspended and spray-dried to obtain fine, free-flowing powder.
- Produces uniform particles with enhanced dissolution.

6. Hot-Melt Extrusion

- Drug is mixed with polymers and processed through an extruder to form a uniform matrix.
- Commonly used for sustained-release and solubility enhancement.

7. Compression Coating

- A core tablet is surrounded by an outer layer through compression.
- Used for sustained release, delayed release, or combination drug delivery.

8. Solvent Evaporation Method

- Drug and polymer are dissolved in a volatile solvent, which is then evaporated to obtain a solid matrix.
- Widely used for microspheres and solid dispersions.

7. Evaluation Parameters (Short)

Evaluation parameters are the criteria used to assess the quality, performance, safety, and effectiveness of a pharmaceutical formulation.

For **sustained-release matrix tablets**, the common evaluation parameters are:

- **Appearance** – Color, shape, and surface characteristics.
- **Weight Variation** – Uniformity of tablet weight.
- **Thickness** – Consistency of tablet dimensions.
- **Hardness** – Mechanical strength of the tablet.
- **Friability** – Resistance to abrasion and breakage.
- **Drug Content Uniformity** – Uniform distribution of the drug in tablets.
- **Disintegration Test** – Time required for tablet breakdown (if applicable).
- **Dissolution Study (In-vitro Drug Release)** – Rate and extent of drug release over time.
- **Swelling Index** – Ability of the matrix to absorb water and swell.
- **Moisture Content** – Amount of residual moisture in the formulation.
- **Stability Studies** – Evaluation of physical and chemical stability under storage conditions.

8. REVIEW OF LITERATURE

Advances in Natural Polymer-Based Sustained Release Matrix Tablets of Ondansetron

Ondansetron hydrochloride is a selective 5-HT₃ receptor antagonist with a short biological half-life (3–5 hours), requiring frequent dosing. To overcome this limitation, sustained release (SR) matrix tablets have been developed to prolong drug release, maintain therapeutic plasma concentrations, and improve patient compliance.

Early studies primarily utilized synthetic polymers such as hydroxypropyl methylcellulose (HPMC), Carbopol, and ethyl cellulose to formulate sustained-release matrix tablets. These formulations successfully extended drug release for up to 24 hours and generally followed Higuchi diffusion-controlled release kinetics.

Recent research has shifted toward **natural polymers** because they are biodegradable, biocompatible, non-toxic, cost-effective, and environmentally friendly. Natural polymers such as **guar gum, xanthan gum, sodium alginate, chitosan, gum karaya, and cellulose derivatives** have demonstrated excellent matrix-forming ability and controlled drug release characteristics.

A notable study by Tuğcu-Demiröz et al. developed ondansetron matrix tablets using **guar gum and sodium alginate**, demonstrating that increasing polymer

concentration effectively slowed drug release and enabled targeted intestinal and colonic delivery.

Current advances focus on combining natural polymers with modern formulation techniques to achieve predictable release profiles, improved tablet integrity, and enhanced patient compliance while reducing the use of synthetic excipients. These developments indicate that natural polymer-based sustained-release matrix tablets are a promising approach for improving the therapeutic efficacy of ondansetron.

9. Future Perspectives

Future research on **natural polymer-based sustained release matrix tablets of ondansetron** should focus on developing safer, more effective, and patient-friendly formulations. Advances in natural polymers such as xanthan gum, guar gum, sodium alginate, pectin, and chitosan can improve controlled drug release, biocompatibility, and biodegradability. Emerging technologies, including Quality by Design (QbD), 3D printing, nanotechnology, and polymer modification, are expected to enhance formulation precision and therapeutic performance. Additionally, more in vivo studies, pharmacokinetic evaluations, and large-scale clinical trials are needed to establish the long-term safety, efficacy, and commercial feasibility of these sustained-release systems. These developments may lead to improved patient compliance, reduced dosing frequency, and better management of chemotherapy-induced nausea and vomiting.

10. CONCLUSION

Natural polymer-based sustained release matrix tablets of ondansetron offer a promising approach to improving antiemetic therapy by providing controlled and prolonged drug release. Natural polymers such as xanthan gum, guar gum, sodium alginate, and HPMC combinations enhance tablet stability, patient compliance, and therapeutic efficacy while reducing dosing frequency and side effects. These polymers are biocompatible, biodegradable, cost-effective, and environmentally friendly, making them suitable alternatives to synthetic polymers. Although further optimization and large-scale clinical studies are needed, advances in natural polymer-based matrix systems demonstrate significant potential for developing safe, effective, and patient-friendly sustained release formulations of ondansetron.

11. REFERENCES

1. Patil H, Tiwari RV, Upadhye SB, Vladyka RS, Repka MA. Formulation and development of pH-independent/dependent sustained release matrix tablets of ondansetron HCl by a continuous twin-screw melt granulation process. *Int J Pharm.*, 2015; 496(1): 33–41. doi: 10.1016/j.ijpharm.2015.04.009.
2. Rajan S, Coalco S, Ramesh N, Meyyanathan SN, Elango K, Suresh B. Once daily sustained release tablets of ondansetron, a novel antiemetic. *Am J PharmTech Res.*, 2013; 3(2): 1–18.
3. Zhang Y, Huang G, Yu Y, Han J, Yu P. Preparation of ondansetron hydrochloride sustained-release tablets and evaluation of drug release behaviour in vitro. *Sheng Wu Yi Xue Gong Cheng Xue Za Zhi.*, 2006; 23(3): 597–600, 614.
4. Tuğcu-Demiröz F, Acartürk F, Takka S. Investigation of colon-specific dosage forms of ondansetron prepared with natural polymers. *Pharmazie*, 2006; 61(11): 916–919.
5. Sharma D, Dev D, Prasad DN, Hans M. Sustained release drug delivery system with the role of natural polymers: A review. *J Drug Deliv Ther.*, 2019; 9(3-s): 913–923.
6. Singh G, Gehalot N, Jain V. Review on formulation and evaluation of sustained release tablet using natural polymer. *J Popul Ther Clin Pharmacol*, 2023.
7. Li L, Zhang X, Gu X, Mao S. Applications of natural polymeric materials in solid oral modified-release dosage forms. *Curr Pharm Des.*, 2015; 21(40): 5854–5867.
8. Agnihotri RDB, Mandekar PS, Kediya A, Mundhada DR. Formulation, characterization and evaluation of sustained release matrix tablet of antiemetic agent. *Pak J Sci Ind Res Ser A Phys Sci.*, 2025.
9. Fazal T, Murtaza BN, Shah M, Iqbal S, Rehman MU, Jaber F, et al. Recent developments in natural biopolymer-based drug delivery systems. *RSC Adv.*, 2023; 13: 23087–23121.
10. Abid M, et al. Natural polymer containing ondansetron mucoadhesive tablets: formulation and evaluation. *Int J Pharm Investig*, 2024; 14(2): 462–471.