International Clinical and Medical Case Reports Journal
Research Article (ISSN: 2832-5788)

Bilayer Tablets: Design, Technologies and Therapeutic Applications

Abhishek Raj[1*] and Dr.Amit Sharma[2]

[1]PhD Scholar (Department of Pharmacy) Faculty of Medical, Paramedical and Allied Health Sciences, Jagannath University, Jaipur, Rajasthan, India

[2]Dean (Medical, Paramedical and Allied Health Sciences) and HOD (Pharmacy), Jagannath University, Jaipur, Rajasthan, India

Citation: *Abhishek Raj, Dr.Amit Sharma. Bilayer Tablets: Design, Technologies and Therapeutic Applications. Int Clinc Med Case Rep Jour. 2026;5(3):1-7.*

Received Date: 18 March 2026; **Accepted Date:** 20 March 2026; **Published Date:** 21 March 2026

***Corresponding author:** Abhishek Raj, PhD Scholar (Department of Pharmacy) Faculty of Medical, Paramedical and Allied Health Sciences, Jagannath University, Jaipur, Rajasthan, India, E-mail: abhishekraj4@gmail.com

Copyright: © Abhishek Raj, Open Access 2026. This article, published in Int Clinc Med Case Rep Jour (ICMCRJ) (Attribution 4.0 International), as described by http://creativecommons.org/licenses/by/4.0/

ABSTRACT

Bilayer tablets are advanced oral solid dosage forms composed of two distinct layers, each formulated to achieve specific drug release profiles or to physically separate incompatible active pharmaceutical ingredients (APIs). These systems enable the combination of immediate-release (IR) and sustained-release (SR) components within a single unit, improving therapeutic efficacy, patient compliance, and pharmacokinetic control. This article reviews the principles, formulation strategies, manufacturing technologies, evaluation parameters, and recent advances in bilayer tablet systems, highlighting their growing importance in modern drug delivery.

Keywords: Bilayer tablets; Sustained Release; SRDF; Matrix System; Modified Release; Extended Release

INTRODUCTION

Oral drug delivery remains the most preferred route due to convenience, cost-effectiveness, and patient acceptability. However, conventional tablets often fail to address complex therapeutic needs such as biphasic release, combination therapy, or drug incompatibility. Bilayer tablets were developed to overcome these challenges by integrating two different formulations into a single dosage unit.

A bilayer tablet typically consists of:

- **Immediate-release layer** for rapid onset of action
- **Sustained- or controlled-release layer** for prolonged therapeutic effect

This dual functionality makes bilayer tablets particularly valuable in chronic disease management, including cardiovascular disorders, diabetes, and pain management.

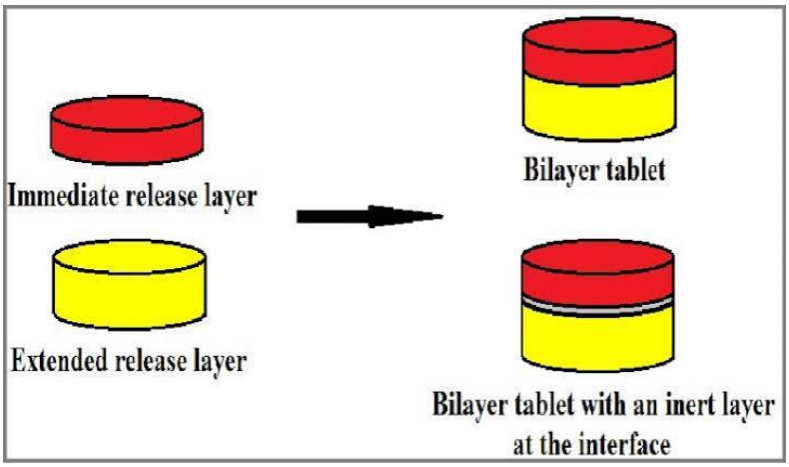

Figure 1: Bilayer Tablets

Rationale for Bilayer Tablet Formulation:

The development of bilayer tablets is driven by several formulation and therapeutic considerations:

- Separation of chemically incompatible drugs
- Achievement of biphasic drug release profiles
- Combination therapy in a single dosage form
- Improved patient compliance (reduced pill burden)
- Controlled pharmacokinetics

Types of Bilayer Tablets:

- **Immediate Release (IR) + Sustained Release (SR) Tablets:** One layer provides rapid drug release, while the second layer maintains prolonged release.
- **Dual Sustained-Release Tablets:** Both layers provide sustained release but with different kinetics or release rates.
- **Combination Tablets:** Contain two different drugs, either in IR or SR forms, for synergistic therapy.
- **Floating Bilayer Tablets:** One layer is designed to float in gastric fluid, prolonging gastric residence time.

Design and Structure of Bilayer Tablets:

Bilayer tablets are generally composed of two layers in which one of the layer is for immediate drug release and the second layer is for sustained drug release. They are designed to physically separate two different Active Pharmaceutical Ingredients (APIs).

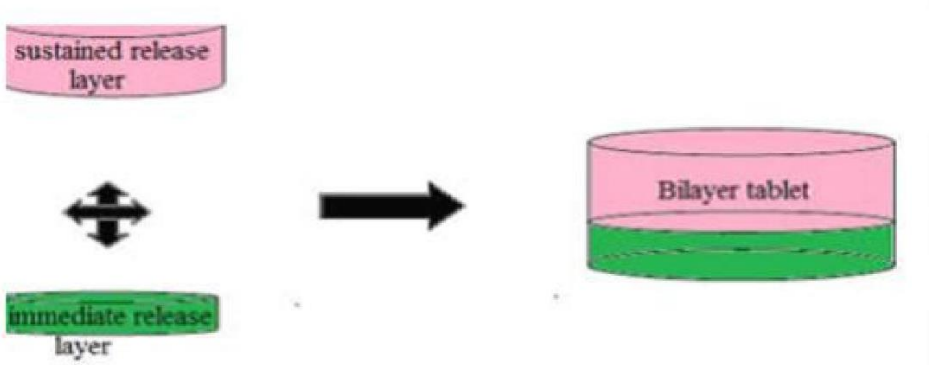

Figure 2: Structure of Bilayer Tablets

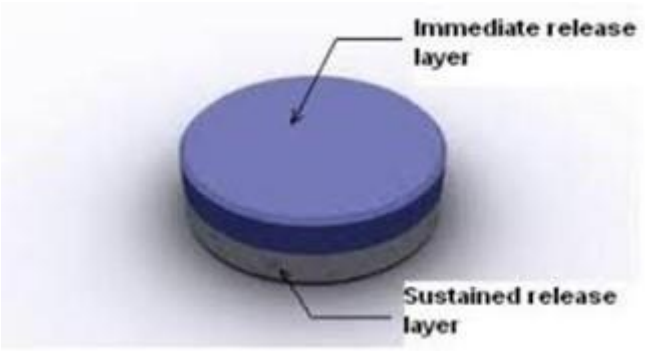

Figure 3: Design and structure of Bilayer Tablets

Key Design Considerations:

- Layer weight uniformity
- Mechanical strength and adhesion between layers
- Prevention of layer separation (delamination)
- Compression force optimization

Manufacturing Techniques:

1. Direct Compression: It is the simplest and most widely used method.
    - First layer is compressed lightly
    - Second layer is added and compressed fully
2. Wet Granulation: Improves flow and compressibility of powders but involves additional processing steps.
3. Roller Compaction: Suitable for moisture-sensitive drugs.
4. Advanced Technologies:
    - Multilayer rotary tablet presses
    - 3D printing for precise layer control

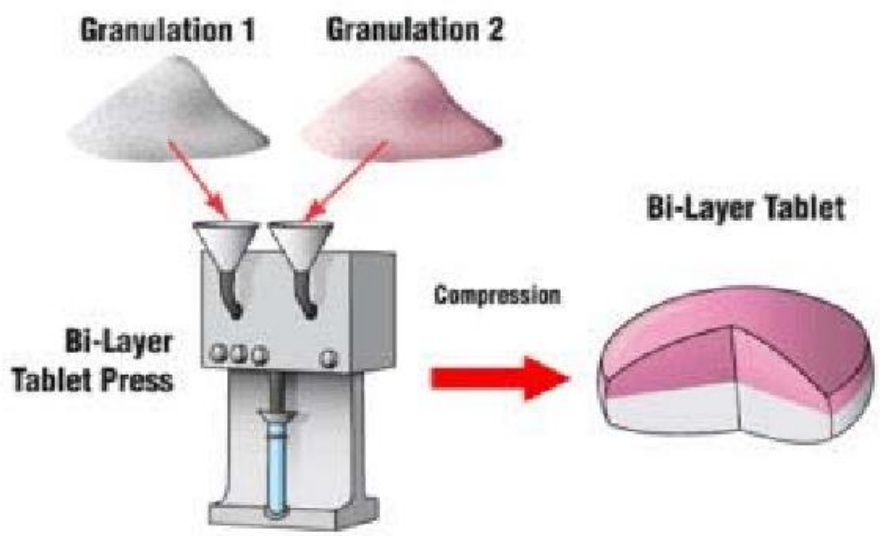

Figure 4: Manufacturing of Bilayer Tablets

Mechanisms of Drug Release: Drug release from bilayer tablets depends on the composition of each layer.

1. Immediate Release Layer: Common mechanisms include;
   - Disintegration and dissolution
   - Rapid drug availability

2. Sustained Release Layer: Common mechanisms include;
   - Diffusion through polymer matrix
   - Polymer swelling and gel formation
   - Matrix erosion

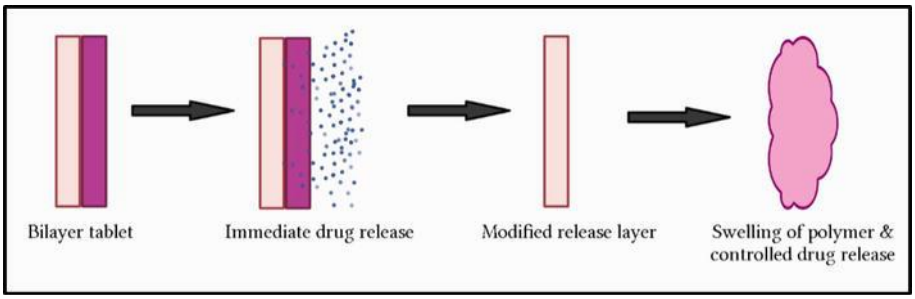

Figure 5: Mechanism of Drug Release

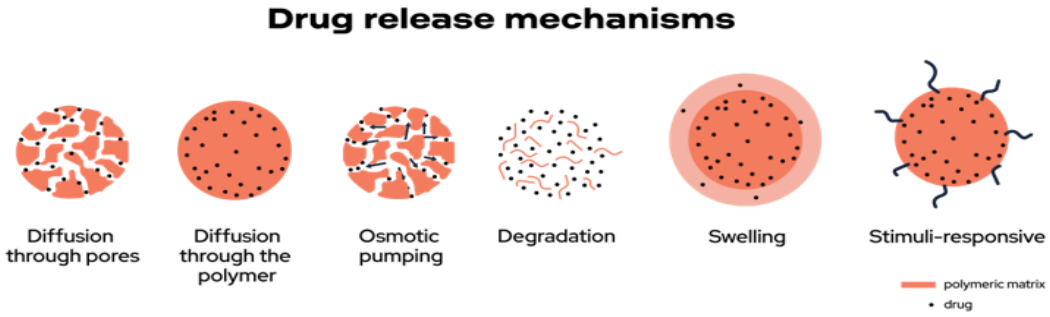

Figure 6: Various Mechanism of Drug Release

Excipients Used in Bilayer Tablets:

Some of the common excipients used in bilayer tablets are:

Table 1: Common Excipients used in Bilayer Tablets

Excipients	Function
Hydroxypropyl methylcellulose (HPMC)	Sustained-release polymer
Microcrystalline Cellulose	Binder and Filler
Sodium Starch Glycolate	Superdisintegrant
Magnesium Stearate	Lubricant
Polyvinylpyrrolidone (PVP)	Binder

Evaluation Parameters: Bilayer tablets are evaluated for various quality control tests.

Table 2: Evaluation of Bilayer Tablets

Parameter	Description
Weight Variation	Ensures uniformity of dosage
Hardness	Mechanical Strength
Friability	Resistance to abrasion
Content Uniformity	Uniform drug distribution
Dissolution	Drug release profile
Layer separation test	Integrity of layers

Advantages of Bilayer Tablets:

- Enables biphasic drug release
- Reduces dosing frequency
- Improves patient compliance
- Allows combination therapy
- Minimizes drug incompatibility

Limitations and Challenges:

- Complex manufacturing process
- Risk of layer separation (delamination)
- Higher production cost
- Difficult scale-up
- Requires specialized equipment

Applications of Bilayer Tablets: Bilayer tablets are designed to deliver and release multiple active pharmaceutical ingredients (APIs) from a single tablet. These tablets are useful in combination therapy to enhance treatment.

Table 3: Therapeutic Applications

Drug Combination	Application
Metformin + Glimepiride	Diabetes Management
Amlodipine + Atenolol	Hypertension
Tramadol IR + SR	Pain Management

Recent Advances in Bilayer Tablet Technology:

Recent innovations have significantly enhanced bilayer tablet systems:

- **3D printing** for precise layer fabrication
- **Nanoparticle-loaded layers** for targeted delivery
- **Floating bilayer systems** for gastroretentive delivery
- **Smart polymers** responsive to pH and enzymes

These advancements allow for **personalized medicine** and improved therapeutic outcomes.

Future Perspectives:

The integration of **material science, nanotechnology, and digital manufacturing** is expected to transform bilayer tablet design. Future research is likely to focus on:

- AI-assisted formulation design
- Personalized bilayer tablets
- Biodegradable and eco-friendly polymers
- Integration with nutraceuticals (relevant to plant-based therapeutics such as *Grewia asiatica*) [1-25]

CONCLUSION

Bilayer tablets represent a versatile and sophisticated drug delivery platform capable of addressing complex therapeutic needs. By combining immediate and sustained release mechanisms within a single dosage form, they enhance drug efficacy, patient compliance, and overall treatment outcomes. Despite manufacturing challenges, ongoing advancements in formulation science and technology continue to expand their applications in modern pharmaceutics.

REFERENCES

1. Jadhav BG. Review on formulation and in vitro evaluation of bilayer tablets. World J Pharm Sci. 2025;13(2).
2. Inamdar I, Ahmed SI. Bilayer tablet overview: A revolutionary approach in sustained drug release & combination drug therapy. J Innov Pharm Biol Sci. 2023;10(3):8–19.
3. Gupta D, Pandey M, Maiti A, Pujari NM. Bilayer tablet technology: A concept of immediate and controlled drug delivery. J Pharm Negat Results. 2023;14(S1):503–512.
4. Acharya M, Dubey G. A critical review on formulation and evaluation of bilayer tablets. Afr J Biomed Res. 2024;27(4S):10705–10710.
5. Vamshi PDC, Suresh V, Bonthagarala B, Varma MM. A review on bi-layered tablets. Indo Am J Pharm Sci. 2023;10(3).
6. Chaudhari A, Ghuge S. A review on bilayer tablet dosage form development and its advancement. Int J Trend Sci Res Dev. 2023;7(1):622–636.
7. Unnati Rajput, N. G. Raghavendra Rao,Anuj Pathak, Ridhima Sharma, Pratibha. Bilayer tablets: An innovative approach for potential drug delivery system. Int J Environ Sci. 2025;11(12s):1550–1573.
8. Garg P, Sain S, Kulshrestha R. A review on bilayer tablet technology. Int J Pharm Biol Sci Archive. 2025;13(6):30–36.

9. Kothamasu S, Rathnakumari G, Thangabalan B. A review on bilayered tablets. Indo Am J Pharm Sci. 2024;11(12).
10. Mourya H, Chauhan R, Joshi R, Akram W, Garud N. Bilayer tablets: A promising novel drug delivery system. Res J Pharm Technol. 2023.
11. Patil M. Bilayer tablets in pharmaceutical technology: Innovation and development. Int J Pharm Sci. 2025;3(8):826–840.
12. Yadav PK, Malik J, Singh G, et al. Formulation and evaluation of bilayer floating tablet containing repaglinide and glipizide. Int J Pharm Sci Res. 2024.
13. Mohammed S, Hussain MA, Khan Z. Bilayer tablets as novel multiparticulate dosage forms: A systematic review. Int J Pharm Pharm Res. 2025.
14. Zhang Y, et al. Smart polymers for controlled drug delivery systems. Adv Funct Mater. 2024.
15. Ebrahimi F, Xu H, Fuenmayor E, Major I. Tailoring drug release in bilayer tablets through droplet deposition modeling and injection molding. Int J Pharm. 2024;653:123859.
16. Appel EA, et al. Injectable and advanced drug delivery systems. *Nat Rev Mater*. 2025.
17. Ouyang J, Zhang Z, Deng B, et al. Oral drug delivery platforms for biomedical applications. Mater Today. 2023;62:296–326.
18. Lu H, Cai Z, Hu P. Polymeric delivery vehicles for sustained drug release. *Pharmaceutics*. 2024
19. Sharma PK, et al. Herbal drug delivery via sustained-release systems. Phytomedicine. 2024
20. Patel VR, Agrawal YK. Natural polymers in drug delivery systems. Int J Biol Macromol. 2024
21. Visan AI, Negut I. PLGA hydrogels for sustained drug delivery. Gels. 2024
22. Withrow AD, Blythe SM, Burton JT. Nanoparticles for sustained drug delivery. Nanomedicine. 2024
23. Sen S, Dong C, Jons CK, et al. Dynamic hydrogels for sustained drug delivery. Biomater Sci. 2025
24. Givarian M, Moztarzadeh F, Ghaffari M. Stimuli-responsive nanocarriers. Drug Deliv Transl Res. 2024
25. Gao Z, Wei Y, Ma G. Sustained-release microspheres in drug delivery. J Mater Chem B. 2023