International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 12 | Dec - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

A Review on Role of Sustained Release Tablets in Improving Patient Compliance and Therapeutic Outcomes

Ujjawal Dubey[2], Vinay panagar[2], Vishal Shrivastav[1], Rohit Baidh[2], Rishu Kumar[2], Gyanesh Kumar Sahu[2*], Harish Sharma[3]

[1]Rungta Institute of Pharmaceutical Sciences

[2]Rungta Institute of Pharmaceutical Sciences & Research

[3]School of Pharmacy, Anjaneya University, Raipur

Corresponding Author:
Dr Gyanesh Kumar Sahu
Professor & Dean
Rungta Institute of Pharmaceutical Sciences & Research, Bhilai
Email- drgyaneshkumarsahu@gmail.com

Abstract

Sustained release tablets represent a significant advancement in pharmaceutical drug delivery, offering controlled and prolonged release of active ingredients to enhance therapeutic outcomes. This novel approach addresses the limitations of conventional dosage forms by maintaining consistent plasma drug levels, reducing dosing frequency, and improving patient compliance. Sustained release systems utilize various technologies, including matrix systems, reservoir systems, and osmotic pumps, to regulate drug release over an extended period. This review provides a comprehensive analysis of the design, formulation strategies, and evaluation techniques for sustained release tablets. It highlights their applications in managing chronic diseases, improving bioavailability, and minimizing side effects. The potential challenges, such as variability in gastrointestinal conditions and cost-effectiveness, are also discussed. By integrating sustained release technology into holistic health management, this approach contributes to more effective, patient-centered therapies.

Keywords-Sustained Release Tablets**,** Controlled Drug Delivery**,** Prolonged Release**,** Matrix Systems**,** Osmotic Pumps

INTRODUCTION

The main goal of drug delivery systems is to deliver precisely the right amount of medication to the location of action so that the body may respond or have the desired therapeutic effect. Two kinds of distribution techniques are often employed. Traditional drug delivery methods, often known as immediate release methods, are defined by their rapid and unimpeded drug the rate of release and release kinetics. The other kind of medication delivery mechanism is modified-release. In these kinds of drug delivery systems, the rate, location, and mechanical performance of the API delivered inside the body are altered in order to provide specific therapeutic responses. These consist of prolonged or extended routes of administration (controlled release, ongoing release, and long-acting dosage forms), delayed or periodic systems for delivering drugs, and targeted drug delivery systems. Since we chose a long-term drug delivery matrix platform for this review paper, only one subject will be covered in depth. Unlike their conventional counterparts, which may require three or four daily doses to get the same therapeutic impact, prolonged-release capsules and tablet form are often taken just once or twice daily. With sustained-release formulations, the medication delivers the intended therapeutic impact right away, and then more drug is released gradually over a specified amount of time to maintain this effect. Patients and caregivers alike benefit from the sustained release dosage form's prolonged medication levels in plasma, which frequently do away with the requirement for nighttime administration. The pharmaceutical industry is becoming more interested in oral medication delivery systems with sustained release. Additionally, designing an amount of product that permits maximum drug loading is highly desired, especially for medications with excellent water solubility. Because of its simplicity of use, comfort, increased design flexibility for dosage forms, ease of manufacture, and cheap cost of production, oral administration is the most widely utilized method for sustained release delivery.

(Fig 1 Sustained release tablet)

SUSTAINED RELEASE FORMULATION

Preparations with controlled drug release over a predetermined duration are known as peroral sustained release formulations. They are meant to be taken orally for treatment. Words like repeated activity, protracted action, and controlled release

SUSTAINED RELEASE FORMULATION DESIGN STRATEGY

The following kinds of peroral sustained-release drugs can be distinguished based on the drug release mechanism:

- **Dissolution controlled sustained-release formulations**.

a) Matrix dissolution control.
b) Matrix dissolution control.

- **Diffusion controlled sustained release formulations.**

a) Matrix diffusion control.
b) Reservoir diffusion control.

- **Osmotic-controlled sustained release formulations.**
- **Sustained release formulations based on ion exchange resin.**

- **pH– independent release formulations.**

RATIONALE FOR DEVELOPING SUSTAINED RELEASE

- To prolong the medication's duration of effect.
- To reduce the plasma level's volatility.
- To lower the dosage's frequency.

ADVANTAGES OF SUSTAINED RELEASE DOSAGE FORMS

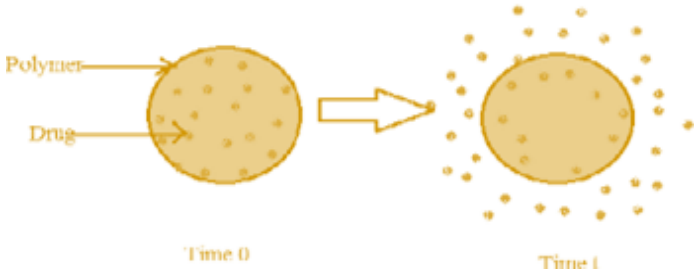
- Increase patient adherence.
- Less variation in medication plasma levels.
- Lower the dosage overall.
- Enhancement of treatment deficiencies.
- Lowering the expense of medical care.

DISADVANTAGES OF SUSTAINED RELEASE DOSAGE FORMS

- A flawed formulation may result in dose dumping.
- More expensive than a typical dose form.
- Less room for dosage modification.
- A higher chance of first-pass metabolism.
- A potential decrease in systemic accessibility.
- Poor relationships between in vitro and in vivo.

MATRIX TABLET

Gastrointestinal solid dose forms known as matrix tablets are made of hydrophilic, hydrophobic, or both polymeric matrices in which the medication is uniformly dissolved or disseminated. Extended-release matrix tablets are made by directly compressing a powdered blend of medication, retardant, and other ingredients to create a tablet that disperses the medication inside a retardant matrix. An alternative is to granulate the medication, retardant mix, and other ingredients before compressing. These systems use diffusion-controlled and dissolution-controlled methods to continuously release the medication.



(Fig 2 Matrix Sustained release tablet)

CLASSIFICATION OF MATRIX TABLETS

On the Basis of Retardant Material	On the basis of porosity of matrix	On the basis of the way of matrix preparations
•Hydrophilic matrix tablet •Hydrophobic matrices •Fat-wax matrix tablet	•Macroporous sysytem •Microporous system •Non-porous system	•Floating matrix system •pH sensitive matrix system •Mucoadhesive matrix system

(Fig 3 Classification of Matrix tablet)

CHARACTERISTICS OF SUSTAINED RELEASE MATRIX

- **Biological characteristics**
- Biological Half-Life
- Absorption
- Distribution
- Metabolism
- **Physicochemical characteristics**
- Dose size
- Aqueous solubility
- Partition coefficient
- Stability
- Protein binding

Biological characteristics

a) Biological Half-Life

While medications with sustained release can lower the frequency of administration, active therapeutic medicines without short half-lives are great possibilities. Generally speaking, medications having half-lives less than two hours are not good choices for formulations with sustained release. Since their effects are already maintained, drugs having half-lives longer than eight hours are likewise often not employed in sustained release formulations.

b) Absorption

In reality, the rate of release of the medication consistent from the dose form ought to match the rate that it is absorbed constant, which is a seeming rate constant. Medications with actual reduced absorption

c) **Distributio**n

Drugs having a large apparent volume of distribution, such as chloroquine, are not good candidates for oral sustained-release pills because they affect the drug's rate of elimination.

d) Metabolism

Drugs that are metabolized in the intestinal lumen or tissue prior to absorption may exhibit reduced bioavailability from slower-releasing dose formulations. The majority of gut wall enzymes are saturable. A full conversion of the medication to its metabolites is made possible by the delayed release of the drug to these areas, which presents less of the drug overall to the enzymatic process throughout a given time period.

Physicochemical characteristics.

a) Dose size

Generally speaking, the maximum amount of a traditional dosage form that may be taken orally is 0.5–1.0 gm in a single dose. This is true for dose formulations with sustained release as well.

b) Aqueous solubility

Drugs that are naturally maintained have very low permeability (less than 0.01 mg/ml). Since 0.1 mg/ml is thought to be the minimum amount of solubility required for a medication to be manufactured in a continuous-release system, the drug's solubility will restrict the mechanism that may be used in the chronic delivery system.

c) Partition coefficient

The medicine must pass across a number of biological membranes during the interval between administration and excretion from the body in order to have a therapeutic impact in another part of the body. Biological membranes are easily penetrated by drugs that have high partition coefficients. Drugs having a high partition coefficient, on the other hand, may either easily pass through membranes and cause a buildup in bodily tissue before being slowly eliminated.

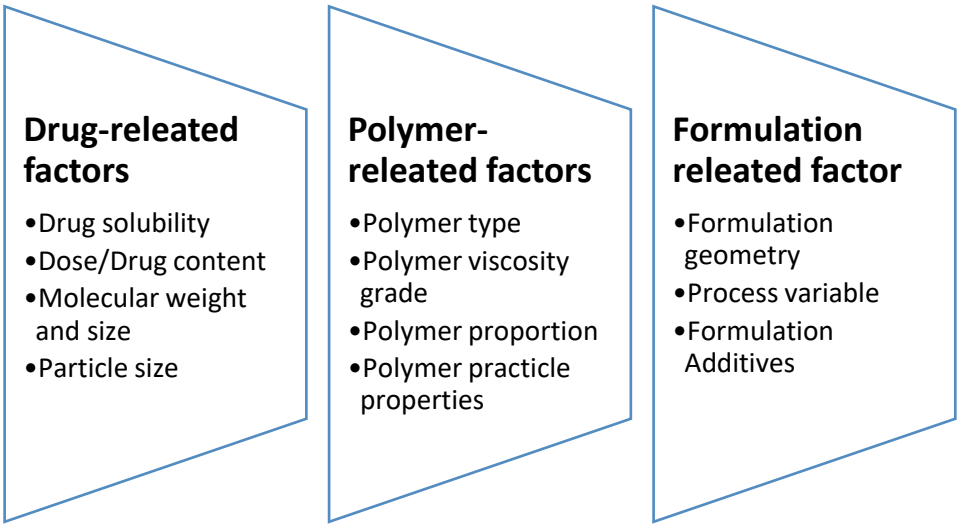
d) Stability

Orally given medications may undergo enzymatic degradation as well as acid-base hydrolysis. For medications that are volatile in the stomach, systems that extend distribution across the GI tract's transits are advantageous. When given from a sustaining dose form, medications that are problematic in the small intestine may exhibit reduced penetration.

e) Protein binding

Numerous medications have the ability to attach to plasma proteins, which can also affect how long they work. When a significant degree of binding of drugs takes place, the protein might act as a depot for the drug, resulting in a protracted release profile.

FACTORS AFFECTING DRUG RELEASE FROM MATRIX SYSTEMS



(Fig 4 Factors Affecting)

METHODS OF PREPARATION

- **Wet Granulation**

This approach involves mixing an adequate amount of the crushing agent with weighed amounts of the medication and polymer. Following the achievement of sufficient cohesion, the mass undergoes screening using a 22/44 mesh screen. After being dried at 40°C, the granules are stored at room temperature in a desiccator. After drying on 44 meshes, the granules were combined with 15% fines. A tablet decompression machine is used to compress the tablets after lubricants and glidants have been applied.

(Fig 5 Wet granulation method)

- **Melt Granulation**

After the bottom layer has been elevated above its melting point, this material can be put over it in a molten state. Organic solvents are not used in melt granulation since the meltable material serves as an insoluble attaching agent. In the melt granulation process, a variety of hydrophobic binders, including the use of palmitostearate, were used.

- **Direct Compression**

This method compresses powdery substances directly without altering the drug's chemical or physical characteristics.

EVALUATION TEST FOR SUSTAINED RELEASE MATRIX TABLETS

a) Weight variation test

Twenty small tablets of the manufactured formulation were assessed using an electronic balance in order to examine weight variance. The test was conducted using the approved procedure, and the mean weight of each tablet was determined.

b) Uniformity of weight

Each pill in the batch should weigh the same, with weight variations falling within acceptable bounds. We calculated the weights to within ±1 mg. A sample comprising 20 pills is used to determine weight control.

c) Dimensions

After that, digital vernier calibrators were used to measure the thickness and circumference to approximately ± 0.01 mm.

d) Hardness

Using a toughness measurement device (Monsanto Type), the tablets' hardness was assessed by diametric compression. It is thought that a tablet rigidity of around 4-5 kg is sufficient for mechanical security.

e) Friability

A Roche friabilator was used to assess the matrix tablets' friability. A sample of tablets or tablets with a known weight (W0) are dedusted in a drum for a predetermined amount of time (100 revolutions) and then weighed (W) once again. The allowed maximum for friability is 1% w/w. The following formula was used to determine the percentage friability based on the weight reduction.

Friability percentage = $W0 - W/W0 \times 100$

f) In vitro dissolution investigation

The United States Pharmacopoeia (USP) dissolving testing equipment II (paddle technique) was used to measure the matrix tablet's release rate. A 900-milliliter container of solvent and a predetermined RPM were used for the dissolving test. At various points, an instance of the resulting solution was taken out of the dissolving device.

FUTURE PROSPECTIVE

In addition to offering efficient therapeutic outcomes, extended-release dosage forms can extend the half-life and bioavailability of pharmaceuticals. As a result, dose frequency will also decrease and enhance patient compliance. By creating a variety of sustained-release matrix tablet products with pharmaceutical active components (APIs), pharmaceutical firms are increasingly taking use of the benefits and increasing acceptability of sustained-release dosage forms to improve patient results. More medications are being placed into sustained-release matrix tablets in anticipation of the future.

CONCLUSION

The long-term release matrix tablets, their benefits and drawbacks, and the many polymers employed to create such a system have been the main topics of this review paper. We may infer from the description above that prolonged release matrix tablets can enhance patient compliance, boost dosage form efficiency, and solve issues with traditional oral drug administration. It is possible to create matrix tablets using a variety of matrix forming polymers, which release the medication in a regulated way.straightforward and reasonably priced matrix tablet formulation technique. As a result, sustained-release matrix tablets are trending toward dosage form design efficiency.

REFERENCES

1. Aulton ME. Pharmaceutics. The Science of Dosage Form Design. 2nd edn. Churchill Livingstone, London: Harcourt Publ Limited; 2005. pp. 296-8.
2. Bharagava, A., Rathore, R. P. S., Tanwar, Y. S., & Gupta, S. (2013). Oral sustained release dosage form: An opportunity to prolong the release of the drug. International Journal of Applied Pharmaceutics and Biomedical Sciences, 3, 7–14.
3. Remington R. The Science and Practice of Pharmacy. 21st ed. Wolter Kluwer Health; 2011. pp. 939 -964.
4. Borguist, P., Korner, A., & Larsson, A. (2006). A model for the drug release from a polymeric matrix tablets-effect of swelling and dissolution. Journal of Controlled Release, 113, 216–225
5. Chugh I, Seth N, Rana AC, Gupta S. Oral sustain release drug delivery system: An overview. International Research Journal of Pharmacy, 2012; 3: 57-62.
6. Brahmankar, D. M., & Sunil, B. (2009). Controlled release medication. In Biopharmaceutics and Pharmacokinetics. International Journal of Pharmaceutics, 400– 406.
7. Brahmankar World Journal of Pharmacy and Pharmaceutical Sciences DM, Jaiswal SB. Biopharmaceutics and Pharmacokinetics: Pharmacokinetics. 2nd ed. Delhi: Vallabh Prakashan; 2009. pp. 399-401.
8. Brazel, C. S., & Peppas, N. A. (2000, January). Modeling of drug release from swellable polymers. European Journal of Pharmaceutics and Biopharmaceutics, 49(1), 47–58. https://doi.org/10.1016/s0939-6411(99)00058-2
9. Kumar S, Kumar H, Kumar R, Kumar A, Malodia K. Design, development and characterization of salbutamol sulphate extended-release matrix tablets. Research Journal of Pharmaceutical, Biological and Chemical Science, 2013; 4: 270-277.
10. Deepika, B., Sameen, S., Nazneen, N., Madhavi, A., Kandukoori, N. R., & Dutt, K. R. (2018). Matrix drug delivery system-a review. Eur. J. Pharm. med Res., 9(2), 150–154
11. Ghori MU, Conway B. Hydrophilic matrices for oral control drug delivery. Am J Pharmacol Sci, 2015; 3: 103-109.

12. Deore, K. R., Kuncha, K., & Theetha, G. T. (2010). Preparation and evaluation of sustainedrelease matrix tablets of tramadol hydrochloride using glycerol Palmitostearate. Tropical Journal of Pharmaceutical Research, 275–281.
13. Chandran S, Asghar LF, Mantha N. Design and evaluation of ethyl cellulose based matrix tablets of Ibuprofen with pH modulated release kinetics. Indian J Pharm Sci, 2008; 70: 596-602.
14. Gautam, S., & Mahveer, S. (2011). Review: Invitro drug release characterization models. International Journal of Pharmaceutical Studies and Research, 2, 77–84.
15. Rancan F, Blume-Peytavi U, Vogt A. Utilization of biodegradable polymeric materials as delivery agents in dermatology. Clin Cosmet Investig Dermatol, 2014; 7: 23-34.
16. Harnish, P., Dhrupesh, R. P., Upendra, P., Jushar, B., & Mayur, S. (2011). Matrix type drug delivery system: A review, Journal of Pharmaceutical Sciences Research and Bioscientific Research, 1, 143–151.
17. Amarjeet D, Ankur R, Seema R, Mu K. Gastroretentive dosage forms: Review on floating drug delivery systems. International Research Journal of Pharmacy, 2011; 2: 72-78.
18. John, C., Chris, M., & Peoral, M.-R. (2003). Dosage form. In M.E.Aluton's Pharmaceutics – The Science of Dosage Form Design. International Journal of Pharmaceutics, 296– 298.
19. Arora G, Malik K, Singh I, Arora S, Rana V. Formulation and evaluation of controlled release matrix mucoadhesive tablets of domperidone using salvia plebeian gum. J Adv Pharm Technol Res, 2011; 2: 163-9.
20. Khyati, P., Upendra, P., Bhavin, B., Ghansyam, P., & Dhiren, D. (2012). Extended-release oral drug delivery system. International Journal of Pharmaceutical Research and Biomedical Sciences, 2, 1–26.
21. Ashish S, Vikas B. Sustained release matrix type drug delivery system: A review. World Journal of Pharmacy and Pharmaceutical Sciences, 2015; 4: 1002-1022.