International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 2 Mar-Apr 2023, pp: 264-279 www.ijprajournal.com ISSN: 2249-7781

Review On: Matrix Release Drug Delivery System

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Submitted: 09-03-2023 Accepted: 18-03-2023

ABSTRACT:
The oral route is a popular and flexible way to provide medication. Both traditional and cutting-edge medication delivery systems have utilised the oral route of administration. Sustained release dosage forms are now outperforming the use of traditional dose forms. The sustained release tablet offers consistent medication release over an extended period. The phrase "controlled release dosage form" refers to a broad category of formulations with extended action that continuously release their active component at a specified rate and duration. The goal of a controlled and sustained drug delivery system is to maximise a medicine's effectiveness by localising it at its site of action, lowering the dosage necessary, ensuring continuous drug administration, minimising the likelihood of side effects, and maintaining.

I. INTRODUCTION:

These are the types of controlled drug delivery systems that continuously release the medication using processes that regulate both diffusion and dissolution. Medications are distributed in swellable hydrophilic substances, an insoluble matrix of stiff non-swellable hydrophobic materials, or plastic materials to regulate the release of the drugs, which have varying solubility qualities. Both hydrophilic and hydrophobic polymers are among the materials most frequently employed in the creation of matrix systems. Hydroxypropyl methylcellulose (HPMC), Hydroxypropyl cellulose (HPC), Hydroxyethyl cellulose (HEC), Xanthan gum, Sodium alginate, Poly (ethylene oxide), and cross-linked homopolymers and copolymers of acrylic acid are examples of commonly found hydrophilic polymers. Small particle size is essential for the quick creation of a gelatinous layer on the tablet surface; hence it is often given in micronized forms. A recent development in the realm of pharmaceutical technology is the matrix tablet as controlled release (CR) drug delivery device. Drug release rate from the dosage form is primarily regulated by the kind and percentage of polymer employed in the preparations, which excludes complicated production processes like coating and palletization during manufacture. For the creation of a controlled release dosage form, hydrophilic polymer matrix is frequently employed.

Controlled Drug Delivery System:

Systems for the controlled delivery of drugs have been created that can regulate the rate of drug delivery, maintain the duration of therapeutic activity, and/or target the delivery of drugs to specific tissues. It is convenient to categorise controlled drug delivery or modified drug delivery systems into four groups. 1) A postponed release 2) Continuous release 3) Targeting by website 4) Targeting receptors Controlled distribution is more specifically understood as 1) Maintaining a relatively constant, effective drug level in the body while simultaneously minimising adverse side effects allows for sustained pharmacological action at a predetermined rate. 2) Targeted drug action by delivering the drug to a specific target cell type using carriers or chemical compounds. 3) Provide a drug release system with a physiological or therapeutic foundation.

Advantage of controlled drug delivery system

1) Prevent issues with patient compliance.
2) Use less overall drug Reduce
- Get rid of local side effects.
- Reduce or stop systemic side effects
- With continued use, the drug's potency will decrease or its action will decrease.
- Reduce drug accumulating by using chronic dosage.

3) Treatment is more effective and quicker at curing or controlling conditions.

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- Improves condition control, reducing medication level fluctuations.
- Enhances the bioavailability of several medications.

E.g.,for instance, taking sustained-release aspirin the night before to treat arthritis in the morning.

4) Economy, i.e., lower health care expenses. A longer course of treatment may be less expensive on average, require fewer doses, have better therapeutic results, and have fewer adverse effects. It takes -less time for medical staff to administer the medication, dispense it, and monitor the patient.

Disadvantage of controlled drug delivery system

1) Insufficient in vivo-in vitro connection.
2) The potential for dose dumping caused by dietary, physiologicalor formulation factors,patient chewing or grinding of oral formulations, which could enhance the risk of toxicity.
3) It is challenging to retrieve a medicine in cases of toxicity, poisoning, or hypersensitivity responses.
4) Lessened possibilities for dosage adjustments for medications that are typically given in different strengths.
5) Issues with stability.
6) A rise in price.
7)Counselling and tolerance development will happen more quickly.
8) The demand for more patient counselling and education.

Factor influencing the conception and effectiveness of controlled medication delivery

1. Drug properties:
- Molecular size
- diffusivity
- protein binding
- partition coefficient.

2. Biological properties:
- cute or chronic therapy
- target locations
- metabolism
- elimination
- dose size
- route of administration
- biological half-life
- disease state
- disease condition.

Oral Drug Delivery

Oral medicine administration is the most common approach. The oral approach is the oldest and most effective way to provide therapeutic drugs since it is less expensive to treat patients and easier to administer, which results in higher patient compliance.Nearly 50% of pharmacological products on the market are taken orally, and historically, oral drug administration has been the primary way to administer medications. A tablet is the most common and often used dosage form. Pharmaceuticals designed for oral use frequently employ traditional or instant-release drug delivery techniques, which are designed for immediate drug release for rapid absorption.

The most practical way to administer medication is orally. To increase patient compliance, numerous oral dose forms have thus far been created. Less potent medications leave the body more quickly because of their shorter half-lives. To achieve the appropriate plasma drug levels, such medications must be given often. The patient compliance may suffer from the higher dose frequency. By structuring the pharmaceuticals This issue can be solved by using matrix-type sustained release medication delivery devices.

The oral route is a popular and flexible way to provide medication. Both traditional and cutting-edge medication delivery systems have utilised the oral route of administration. Sustained release dosage forms are now outperforming the use of traditional dose forms. The sustained release tablet offers consistent medication release over an extended period. The phrase "controlled release dosage form" refers to a variety of formulations with extended action that continuously release their active component at a predefined rate and duration. Through localisation at the site of action, dosage reduction, continuous drug administration, decreased incidence of side effects, and preservation of drug concentration in the body, in order to reduce dosage frequency or increase treatment effectiveness, sustained or controlled drug delivery systems are used.

The following are the primary issues that might make the development of oral controlled medication delivery systems difficult:

1) **The development of a medication delivery system**: The development of an efficient oral controlled release drug delivery system capable of delivering a medication to a target location at a therapeutically effective rate

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during the time period required for an efficient course of therapy.

2) **Gastrointestinal transit time modification**: In order to maximise the administration of a pharmaceutical dose, it is necessary to change GI transit time so that the intended drug delivery system can go to a target site or a position nearby an absorption site and stay there for a long time.

3) **Hepatic first-pass elimination reduction**: If the drug being administered is going to be subjected to a lot of hepatic first-pass elimination, precautions should be taken to either avoid or reduce the hepatic metabolic effect.

Drug Delivery System in a Matrix

These are the several types of continually releasing controlled pharmaceutical delivery systems using both Diffusion- and dissolution-controlled methods are both used. To manage the release of the pharmaceuticals, which have different solubility properties, medications are distributed in swellable hydrophilic substances, an insoluble matrix of hard non-swellable hydrophobic materials, or plastic materials.

The advent of the matrix tablet as sustained release (SR) has sparked innovation for a cutting-edge drug delivery mechanism in the field of pharmaceutical technology. How rapidly the drug is released from the dosage form is mostly determined by the kind and concentration of polymer used in the preparations. During manufacture, complex industrial procedures like coating and pelletization are not involved.

Systems with a matrix architecture are frequently utilised for sustained release. The medicine that is dissolved or distributed is released over a longer period and under control by the release system. A matrix is really described as a well-combined mixture of one or more pharmaceuticals with a gelling agent, such as hydrophilic polymers. The sustained release method can be used to achieve a therapeutically effective concentration in the systemic circulation over a longer period, enhancing patient compliance.

The drug will initially be rapidly released after dissolving any drug particles that are on the release unit's surface. Then, drug particles will disintegrate and be discharged outside the release unit through diffusion in the pores at successively increasing distances from release unit surface. In this approach, the drug reservoir is created by uniformly dispersing drug particles inside a matrix of rate-regulating polymers made of either hydrophilic or lipophilic polymers.

The drug is dispersed throughout the polymer matrix by mixing a therapeutic dose of finely ground drug particles with a liquid polymer or a very viscous base polymer, followed by cross-linking the polymer chain while mixing the drug and polymer at a high temperature.

Advantage Of Matrix Tablets

- convenient to produce
- Use of less medication overall.
- Reduce the negative local and systemic consequences.
- Flexible, efficient, and reasonably priced Slow down medication absorption to lessen toxicity.
- An increase in the effectiveness of the therapy.
- With persistent dosage, reduce drug build-up.
- Utilizing sustain release formulations helps to reduce excessive blood concentration.
- The development of unique impactcapabilities.
- Has the ability to release high-molecular-weight compounds under control.
- The therapeutic concentrations might be maintained by sustained release formulations for a very long time.
- By shielding the medication from the gastrointestinal tract's hydrolysis or other derivative modifications you can increase stability.
- The patient compliance may be increased by sustain release formulations

Disadvantage Of Matrix drug delivery system

- A specific polymeric matrix cannot be used to combine all medications.
- Once the medicine has been released, the residual matrix must be taken out.
- It is challenging to achieve zero order release.
- The release rates of medications are influenced by time's square root.

Matrix Release Drug Delivery System Classification

Based on the fire-retardant substance used:

Matrix tablets can be divided into 5 types.

1. Plastic matrices (hydrophobic matrices)

In this technique, the medication is combined with an inert or hydrophobic polymer

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and crushed into a tablet to achieve prolonged release from an oral dosage form. The medication that is dissolving has diffused through a network of channels that are present between compressed polymer particles, resulting in sustained release. In these formulations, liquid penetration into the matrix is the rate-regulating step. Diffusion is a potential medication release mechanism in these types of tablets.

2. Lipid Matrix

These matrices were created using lipid waxes and associated substances. Drug release from these matrices happens via pore diffusion as well as erosion. Therefore, release properties are more sensitive to the nature of the digestive fluid than they are to a polymer matrix that is completely insoluble. For several prolonged release formulations, carnauba wax has been used as the retardant base in conjunction with stearyl alcohol or stearic acid.

3. Hydrophilic Matrices

Because of their versatility in achieving a desired drug release profile, economic effectiveness, and widespread regulatory acceptability, hydrophilic polymer matrix systems are often utilised in oral controlled drug delivery. In the realm of controlled release, there is special interest in the formulation of medications in gelatinous capsules or, more commonly, tablets employing hydrophilic polymers with high gelling capabilities as base excipients. Infect a matrix is described as a thoroughly combined combination of one or more pharmaceuticals with a gelling agent (hydrophilic polymer). These devices are referred to as swellable controlled release systems.

4. Biodegradable matrices

These systems contain monomers that are connected to one another by functional groups and have a weak backbone bond. By enzymes produced by nearby live cells or by non-enzymatic processes, they are physiologically eroded or destroyed into oligomers and monomers that can be metabolised or expelled.

5. Minerals matrices

These are made up of polymers that come from different kinds of seaweed. An instance is alginic acid, a hydrophilic carbohydrate produced from brown seaweed species (Phaephyceae) using diluted alkali.

Based on Matrix Porosity: Matrix systems may be categorised based on their porosity, leading to the identification of Macro porous, Micro porous, and Nonporous systems.

i. Macro-Porous System

In these systems, drug diffusion occurs through matrix pores that are between 0.1 and 1 m in size. The diffusant molecule is larger than this pore size.

ii. Micro-Porous System

Diffusion mostly occurs through pores in this type of structure. Micro porous systems typically have pores with a size between 50 and 200 A°, which is a little larger than the size of diffusing molecules.

iii. Non-Porous System

Molecules diffuse over network meshes in non-porous systems because they lack pores. In this instance, there is no pore phase; only the polymeric phase exists.

Method of Preparation of Matrix Tablet:

A. Wet Granulation Technique:

- excipients, polymer, and medication are milled and combined.
- Making the solution binders.
- The filtration of moist matter.
- Adding a granulating or binder solution while wet massing.
- The wet grains are dried.
- Dry granule screening.
- Blending to create "flowing powder" by adding lubricant and disintegrant.
- Tablet compression

B. Dry Granulation Technique:

- Drug, polymer, and excipients are ground and combined.
- The formation of slugs or roll compaction.
- Slugs and powder that has been compressed are milled and screened.
- Combining lubricant and disintegrant the tablet's compression.

C. Melt granulation Technique:

- In a porcelain dish over a water bath that is kept at a consistent temperature, wax is melting.
- The hot wax was continually stirred while the drug was progressively introduced.

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- After the molten substance had cooled to normal temperature, it solidified.
- The substance that had formed was broken up in a mortar and then sieved.
- The sieve-passed granules were combined with Glidant and compacted into a tablet using a single punch tablet machine with a 10 mm deep concave punch.

Principle of melt granulation:
Granulation process are divided in three different phases

- Wetting and nucleation, in nucleation two mechanisms immersion and dispersion is proposed.
- Coalescence
- Attrition and breakage.

Wetting and nucleation:
When the binder and powder bed come into contact in this stage, liquid bridges are created that eventually lead to the creation of tiny agglomerates. Two processes are involved in nucleation: (a) Immersion (b) Distribution

a. Immersion:
Nucleation by immersion happens when the size of the molten binder droplets is greater than that of the microscopic solid particles.

b. Distribution:
By using this technique, the molten binding liquid is smeared across the surfaces of the collision of wetted particles results in the creation of tiny solid particles and nuclei.

Coalescence step:
It involves nuclei that still contain surface liquid to encourage effective nuclear fusion the surface liquid makes the nuclei more malleable and is crucial for permitting the deformation of the nuclei's surface for coalescence as well as for boosting granulation's rounding.

Attrition and breakage step:
Attrition and breakage are terms used to describe the occurrence of granulation fragmentation in which solidification occurs when a tray is cooled to room temperature without the requirement for tumble drying.

D. Sintering Technique:

- By applying heat, sintering is the process of fusing neighbouring particle surfaces together to form a compact or a mass of powder.
- In traditional sintering, a compact is heated at a temperature below the melting point of the solid materials under regulated conditions with air pressure.
- Sintering was used to explain how tablets held at high temperatures changed in terms of their hardness and time to dissolve.
- In order to stabilise and delay the release of the medicine, sustained release matrix tablets have been made using the sintering technique.

Drug ReleaseMatrix Tabletsmechanisms:
Diffusion:
Prior to diffusing out of the matrix, the medication first dissolves in the outer layer that is in touch with the bathing solution. During this process, the bathing fluid is still coming into touch with the solid drug. To control the diffusion of this system, the dissolving rate of drug particles within the matrix must be significantly faster than the diffusion rate of dissolved drug exiting the matrix.

Osmosis:
Osmotic pressure can be generated inside the inside of the tablet under the correct conditions when water is permitted to enter. Because of this, the medicine is released from the tablet via the coating and onto the exterior.

Erosion:
In some circumstances, the matrix can be made to progressively degrade over time, delivering the medicine in the tablet.

Release-Limiting Factor Effect on Drug Release
The regulated release of pharmaceuticals from either capsules, matrices, or sandwich-style drug delivery systems is mechanically analysed to reveal that partition coefficient, diffusivity, diffusional route thickness, and other system characteristics play distinct rate-determining roles.

Drug solubility
Drug release from swelling and erosion-controlled polymeric matrix is significantly influenced by its molecular size and water solubility. Drugs with adequate aqueous solubility are released by dissolving in an infiltrating media, while those with insufficient solubility are released

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by both dissolving the drug itself and dissolving drug particles by erosion of the matrix tablet.

Polymer diffusivity

Small molecule diffusion in polymer structures is an energy-activated process in which the diffusant molecules move to a series of equilibrium positions after acquiring an adequate amount of activation energy (Ed) for diffusion. Ed depends on the length of the polymer chain segment, cross-linking, and crystallinity of the polymer. The three variables—polymer particle size, viscosity, and concentration—can each be linked to the release of a medication.

Polymer hydration

The process of polymer hydration and swelling needs to be studied for as many different types of polymers and polymeric combinations as possible. The more crucial steps in polymer dissolution are water absorption or adsorption in more accessible locations, rupture of polymer-polymer linking with the concurrent formation of water-polymer linking, chain separation, swelling, and finally chain dispersion in dissolution medium.

Solution solubility

All in vitro drug release investigations should be carried out under ideal sink conditions given that the in vivo (biological) sink condition is actively maintained by hem perfusion. This will allow for a more accurate simulation and connection between the in vitro drug release profile and the in vivo medication delivery. Maintaining a sink state is essential to ensuring that the delivery method alone controls drug release, unaffected or complicated by solubility.

Volume and Surface area

It is well understood theoretically and experimentally that the surface area of the drug delivery device affects the rate of drug release. The surface area of the dosage form is found to affect the rate of drug release both in vitro and in vivo. According to Siepman et al., smaller cylindrical tablets release faster than larger ones**.**

Diluent's effect

The type of diluent determines the effect of the diluent or filler. While insoluble diluents like dicalcium phosphate lower the Fickian diffusion and increase the relaxation (erosion) rate of the matrix, water soluble diluents like lactose significantly boost drug release rate and shift the release mechanism towards it. This is because water-soluble fillers in matrices encourage water penetration into the interior of the matrix due to an increase in hydrophilicity in the system, which causes fast drug diffusion and an increase in drug release rate.

Physicochemical Factors Influencing Release from Matrix Tablet

Dose Size

There is a maximum bulk size of the dosage that can be supplied for systems that are to be taken orally. For a traditional dosage form, a single dose of 0.5–1.0g is often regarded as the maximum. The same is true for dosage forms with sustained release. Compounds that require large dosing sizes can occasionally be administered in multiple doses or made into liquid systems. The margin of safety involved in administering a large quantity of a medication with a limited therapeutic range is another factor to consider.

Partition coefficient:

A medicine must pass through several different biological membranes after being given to the GI tract in order to have a therapeutic impact elsewhere in the body.Compounds with high partition coefficients that are lipophilic in nature are poorly soluble in water and stay in the lipophilic tissue for a prolonged period. Compounds with an extremely low partition coefficient have a difficult time penetrating the membrane, which reduces their bioavailability. The drug's partitioning properties must play a significant role in the selection of diffusion-limiting membranes.

pKA, ionization and water solubility:

Drugs are often weak bases or acids. It is significant to understand the connection between the compound's pka and the absorptive environment since an unaltered version of a medicine preferentially crosses lipid membranes. The drug's solubility in aqueous fluids will also be a factor in delivery methods that rely on diffusion or dissolution. These dosage forms must work in a pH-changing environment, with the stomach being acidic and the small intestine being more neutral; the impact of the release mechanism must be described. Because the drug's dissolution will restrict the release of substances during the period of a dose form in the GI tract, substances with extremely low solubility (0.01 mg/ml) are intrinsically maintained. Therefore, it follows that

International Journal of Pharmaceutical Research and Applications
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compounds with low solubility will be poor candidates for medications that are just minimally soluble since they will have low concentrations of the drug in solution, which is the driving force for diffusion.

Stability:

Acid-base hydrolysis and enzymatic breakdown are also possible outcomes of oral medication administration. Drugs in the solid state will degrade less quickly, hence this is the preferred composition of delivery for challenging situations. Systems that extend delivery across the whole course of transit in the GI tract are advantageous for dosage forms that are unstable in the stomach. This is also true for systems that delay release until the dosage form reaches the small intestine. When taken from a sustaining dose form, drugs that are unstable in the small intestine may exhibit lower bioavailability. This is because the small intestine is where most medications are administered and are therefore degraded.
Probanthine and propantheline are two examples of this type of medication.

Drugs used	Category	Polymer used	Method used
Ondansertan	Anti-hypertensive	HPMC-K100M, HPMC-K4M, HPMC-K15M	Wet Granulation
Nicorandil	Ca+2 channel blocker	HPMC, CMC, EC	Wet Granulation
Naproxen	Morphine antagonist	HPMC-K100M,HPMC K15M, PVP	Direct Compression
Metoclopromide	Anti-emetic	HPMC, CMC, EC, SSG	Direct Compression / Wet Granulation
Losartan potassium	Anti-hypertensive	HPMC-K100M, HPMC-K4M, Eudragit-RSPO	Direct Compression
Itopride HCL	Prokinetic agent	HPMC-K100M, HPMC-	Direct

Table1: Polymer-based matrix tablet formulation and manufacturing process.

Biological component affecting matrix tablet release:

- **Biochemical half-life**
- **Absorption**
- **Distribution**
- **Metabolism**
- **binding of proteins**
- **Safeguarding margin.**

Typically, the main goal of an oral SR medication is to maintain therapeutic blood levels for an extended period. Drugs must achieve this by entering the bloodstream at a pace that is almost equivalent to their rate of removal. The quantitative description of the elimination rate is the half-life (t1/2).Each medication has a unique characteristic elimination rate, which is the total of all processes that permanently remove the drug from the bloodstream, including metabolism, urine excretion, and all other processes. Short-half-life

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therapeutic substances are often a great option for SR formulation since it can lower dose frequency.

Levodopa and furosemide are examples of medications having a half-life less than two hours that make them poor candidates for SR preparation. Since their effects are already maintained, compounds having half-lives longer than 8 hours are likewise often not employed in sustaining form. Examples include phenytoin and digoxin.

Absorption:

The rate of release must be substantially slower than the rate of absorption since the goal of creating an SR product is to exert control over the delivery mechanism. The maximal half-life for absorption should be around 3–4 hours if we consider that most medications transit through the GI tract within 8–12 hours. Otherwise, the device will leave the possible absorptive regions before the drug release is finished. Thus, to give 80–95% during this time period, corresponds to a minimum apparent absorption rate constant of 0.17–0.23h-1. SR preparation may be detrimental to absorption if a medicine is absorbed by active transport or if transport is restricted to a particular area of the gut. One strategy for providing chemicals with sustained delivery mechanisms involves keeping the compounds in the stomach. As a result, the medication can be released gradually and reach the absorptive location. These techniques were created as a result of the discovery that co-administration has sustained effects. The creation of low-density pellets or capsules is one such endeavour. The use of bio adhesive materials is another strategy.

Metabolism:

Drugs that are considerably processed in the intestine's tissue or lumen prior to absorption may have reduced bioavailability when taken in slower-releasing dose forms.Therefore, the following requirements must be met before a medicine may be utilised to create a sustained-release dosage form.

- Drugs should have low half-life.
- Drugs should be freely soluble in water.
- Drugs should have larger therapeutic window.
- Drugs should be absorbed throughout the GIT.

A medicine can be produced in SR dose form even if it has low water solubility. To do this, the drug's solubility must be enhanced using the appropriate method before being synthesised in the SR dosage form. But currently, it is important to avoid drug crystallisation, which occurs when the drug enters the systemic circulation, and to take precautions to avoid it.

Distribution:

A bad choice for the oral SR drug delivery system is a medicine having a high apparent volume of distribution, which affects the drug's rate of elimination, such as chloroquine.

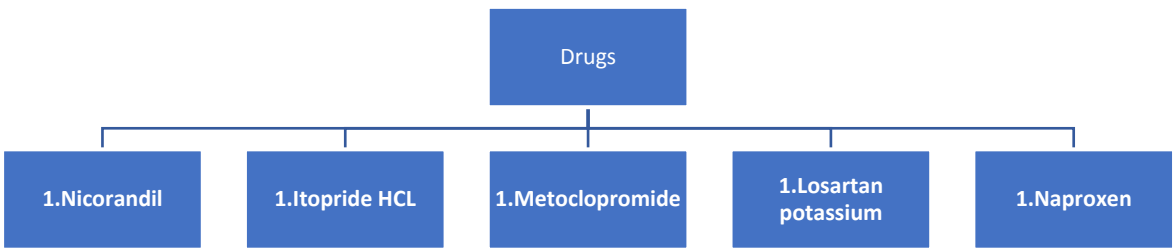
Protein binding:

Drugs are all to some extent bound to plasma and/or tissue proteins, however the pharmacological response is dependent on the drug's unbound concentration rather than its total concentration. Regardless of the dose form, the drug's ability to bind to proteins affects its therapeutic efficacy. Because substantial binding to plasma lengthens biological half-life, SR drug delivery systems are not always necessary for these kinds of medications.

Margin of safety:

As we all know, the safer a medicine is, the higher its therapeutic index value. Due to the lack of technical control over release rates, medications with low therapeutic indices are often poor candidates for formulation of oral SR drug delivery systems.

Some Drugs used in matrix release drug delivery system i.e.;



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Nicorandil:

The two most prevalent cardiovascular conditions, hypertension, and angina pectoris, call for regular observation. Potassium channel openers are currently regarded as a significant class of medications for angina pectoris and hypertension. Nicorandil, a powerful cardiac vasodilator, is the first therapeutic medication to be demonstrated to have the capacity to hyperpolarize smooth muscle cell membranes.

Although nicorandil is one of the newly discovered molecules for the treatment of angina and hypertension, maintaining blood pressure at a normal physiological level is the key to a successful course of therapy, and this requires a consistent and even flow of the medication.

The most popular technique for controlling medication release is to include it into a matrix system. Hydrophilic polymer matrix systems are often employed in oral controlled drug delivery due to their adaptability, which helps them achieve a desired drug release profile, cost effectiveness, and widespread regulatory acceptability. The goal of the current work is to create nicorandil once-daily sustained-release matrix tablets employing sodium carboxymethylcellulose (CMC), hydroxypropyl methylcellulose (HPMC), and sodium alginate as hypothesised hydrophilic matrix components. Due to the quick diffusion of the dissolved drug via the hydrophilic gel network, the extended period of drug release utilising a hydrophilic matrix method is constrained, especially for highly water-soluble medicines.

Materials and Method used:

Materials:

BDH Chemicals provided HPMC (K4M), CMC (high viscosity), and sodium alginate (high viscosity) (Mumbai, India). A 14-cps supply of ethyl cellulose was bought from SD Fine Chemicals Ltd. (Mumbai India). Loba Chemie provided PVP (K30) (Mumbai, India). Rohm Pharma provided ERL and ERS for purchase (Weiterstadt, Germany). Wokhardt Pharmaceuticals gave Nicorandil as a gift (Mumbai, India). All other substances were of a high analytical grade**.**

Method:

Preparation of tablets:

Wet granulation was used to create several tablet compositions (Formulations I-IX, Table 1). The American Society of Testing and Materials' (ASTM) 80 mesh was used to filter all the particles. The necessary amounts of medication and polymer were thoroughly combined, and an adequate amount of the granulating agent (ethanolic solution of EC, ERL, (ERS, PVP) was gradually introduced. The bulk was sieved through 22/44 mesh once a sufficient level of cohesion had been attained. The granules were first dried at 40°C for 12 hours, and then they were maintained at room temperature in a desiccator for another 12 hours. The granules retained on 44 mesh were combined with 15% of particles after drying (granules that passed through 44 mesh).

Evaluations of tablets

Angle of repose:

The funnel technique was used to calculate the granules' angle of repose. Granules that had been precisely weighed were placed in a funnel. The funnel's height was adjusted such that the tip of the funnel just brushed the summit of the granules' mound. The funnel was left open, allowing the grains to freely discharge onto the surface. The powder cone's diameter was measured, and the following equation was used to get the angle of repose:

Tan□ = h/r (1)

where h and r are the powder cone's height and radius.

Bulk Density:

Both the loose bulk density (LBD) and the tapped bulk density (TBD) were calculated. A 10-mL measuring cup was filled with 2 g of powder from each recipe after it had been briskly shaken to break up any agglomerates. cylinder. After the initial volume was measured, the cylinder was allowed to drop by itself from a height of 2.5 cm to a hard surface at intervals of 2 seconds. The tapping persisted until there was no longer any loudness change.

The following formulae were used to compute LBD and TBD.

LBD is equal to the product of the powder's weight and the packing's volume.

TBD is equal to the product of the powder's weight and the packing's tapped volume.

Compressibility Index:

The granules' compressibility index was calculated using Carr's compressibility index.

(TBD - LBD) * 100/TBD = Carr's index (%)

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Total porosity:
The real volume of granules (the space occupied by the powder) and the volume occupied by a chosen weight of powder (Vbulk) were measured to estimate the total porosity.
not include areas bigger than the intermolecular space:
% Of porosity = Vbulk - V/V bulk 100

Drug content:
Water was used to extract 100 mg of powdered nicorandil granules, and the resulting mixture was then filtered using a 0.45- membrane.
At 262 nm, the absorbance was measured after the proper dilution.

II. RESULT:

Angle of repose, LBD, TBD, compressibility index, total porosity, and drug content of the granules of various formulations were all assessed **(Table 2**).

Tablets	Angle of Repose	Loose Bulk Density (g/mL)	Tapped Bulk Density (g/mL)	Compressibility Index (%)	Total Porosity (%)	Drug Content (%)
F-I	24.50 ± 0.02	0.506 ± 0 .02	0.582 ± 0.04	13.08 ± 0.02	27.43 ± 0.03	98.55 ± 0.03
F-II	21.20 ± 0.02	0.493 ± 0.03	0.555 ± 0.03	11.25 ± 0.03	26.97 ± 0.02	95.53 ± 0.04
F-III	22.10 ± 0.01	0.512 ± 0.04	0.581 ± 0.02	11.82 ± 0.03	26.92 ± 0.03	96.51 ± 0.03
F-IV	29.85 ± 0.02	0.289 ± 0.03	0.335 ± 0.04	13.75 ± 0.02	37.03 ± 0.03	97.54 ± 0.02
F-V	24.11 ± 0.03	0.283 ± 0.03	0.325 ± 0.06	12.95 ± 0.03	37.61 ± 0.04	96.79 ± 0.04
F-VI	23.95 ± 0.01	0.304 ± 0.02	0.349 ± 0.02	12.92 ± 0.04	34.27 ± 0.02	98.55 ± 0.02
F-VII	22.68 ± 0.03	0.289 ± 0.04	0.335 ± 0.03	13.45 ± 0.04	37.03 ± 0.04	97.62 ± 0.04

Table1: Granulations' characteristics*

III. CONCLUSION:

The explanation makes it clear that sustained-release formulations are beneficial for boosting dosage effectiveness and for increasing patient compatibility. Drug release from matrix tablets is significantly regulated by the release retarding substance employed in the matrix. Even if there are several release retarding agents and polymers on the market, there is always a need to create new, more effective ones for matrix tablets. Furthermore, all of these are reasonably priced. When it comes to antibiotics, where inappropriate use of the drug might lead to resistance, the dose form is simple to adjust and extremely beneficial.

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Volume 8, Issue 2 Mar-Apr 2023, pp: 264-279 www.ijprajournal.com ISSN: 2249-7781

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BRIEF PROFILE:

Currently pursuing Bachelor of pharmacy from Guru Nanak College of Pharmaceutical Science, Dehradun affiliated to Uttarakhand Technical University, Dehradun.

CAREER OBJECTIVE:

To get an opportunity to grow professionally and to maximize my potential for the benefit of an organization, and to acquire a respectable position within that same organization.

ACADEMIC STATUS/QUALIFICATIONS

Sr. No.	ACADEMIC QUALIFICATIONS	BOARD/ UNIVERSITY	YEAR OF COMPLETION	PERCENTAGE
1	B. PHARMACY	Uttarakhand Technical University, Dehradun.	2023	8 CGPA
2	10th	Manan Vidya Manrakhan Mahto School, Ranchi	2016	86.4
3	HIGH SCHOOL	Manan Vidya Manrakhan Mahto School, Ranchi	2018	64

CONFERENCES/SEMINARS/WEBINARS:

- "International conference on "**Drug Discovery, Design and Delivery Approaches**," organized by Guru Nanak College of Pharmaceutical Sciences, Dehradun and Kingston Imperial Institute of Technology and Sciences, Dehradun on **26 November,2022.**
- National workshop on "**Ethics & Basics of**

International Journal of Pharmaceutical Research and Applications
Volume 8, Issue 2 Mar-Apr 2023, pp: 264-279 www.ijprajournal.com ISSN: 2249-7781

Research Paper Writing & Publication", in collaboration with International Journal of Pharmaceutical Sciences and Research (IJHPSR- Scopus, EMBASE-Elsevier's and PubMed), International Journal of Pharmaceutical Sciences and Drug Research (IJPSDR-UGC Approved) at BFIT Group of Institution, Dehradun, Uttarakhand. Organized by Guru Nanak College of Pharmaceutical Sciences, Dehradun & Kingston Imperial Institute of Technology & Sciences, Dehradun on **07 December 2022.**

ORAL/POSTER PRESENTATION

- Oral presentation on "**Matrix Release Drug Delivery System"** in International Conference on "Drug Discovery, Design and Delivery Approaches" is being organized with the collaboration of Association of Pharmaceutical Teachers of India (APTI)*, Indian Pharmaceutical Association *(IPA) and International Journal of Pharmaceutical Sciences and Drug Research (IJPSDR-UGC Approved). On 26th November 2022, Saturday at BFIT Auditorium, BFIT Group of Institutions, Sudhowala, Dehradun, Uttarakhand.

SKILLS

- Sales driven.
- Team management.
- Leadership.
- Management skill.
- Comfortable in Three Languages (Hindi, English and Bhojpuri)

STRENGTHS

- Friendly and positive communicator.
- Flexibility and Adaptability.
- Compelling relationship builder.
- Team oriented attitude.

PERSONAL PROFILE

- Father's Name: **Mr. Binod Kumar Singh**
- Mother's Name: **Mrs. Bebi Singh**
- Category: GENERAL
- Date of Birth: 03 February 2001
- Blood Group: AB+ve

DECLARATION

I hereby declare that all the above information is true to the best of my knowledge.
Date: 26December,2022.
SIGNATURE

SASHANK SHEKHAR
Place: Dehradun