International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Review on : Matrix Drug Delivery System

Ms. Jyoti Shelke[1] , Mr. Vishal Gaikwad[2] , Mr. Vikas Wamane[2]

[1].Final Year B pharmacy Student , Pratibhatai Pawar college of pharmacy Shrirampur , Maharashtra ,India

[2.]Department of Pharmaceutics

ABSTRACT:

The popular and convenient drug administration route is oral. For both traditional and cutting-edge medication delivery systems, oral route of administration has been used. For medications that are given orally but have a high dose frequency and short half life, an oral controlled release drug delivery device becomes a very interesting method. Matrix tablets are an important tool in the development of oral controlled release dosage forms.This review focuses on the different types of matrix systems depending on the polymer employed and the porosity of the matrix system, such as hydrophilic, hydrophobic, and hydrophobic matrix systems.The goal of a sustained or controlled drug delivery system is to reduce the frequency of dosing or increase the efficacy of a drug by localising it at the site of action, lowering the dose required, providing continuous drug delivery, reducing the incidence of adverse effects, and maintaining drug concentration in the system. The goal of this review is to have a thorough understanding of the matrix drug delivery system.

Keywords:Matrix tablet, hydrophilic polymer, controlled release.

Introduction

Oral Drug Delivery System

The oral route is the most commonly used methoddrug management. The oral cavity is also the oldestan appropriate way to manage medical agentsdue to low treatment costs and conveniencemanagement leads to a higher level of patientobedience. About 50% of drug products are availablein the market they are treated orally and historically,Oral drug administration has been a major route fordrug delivery. Tablets are the most common as wella widely used volume form.[1]Oral method is the simplest form of drugto manage. To date many oral dosage forms are still availabledesigned to improve patient compliance. Idrugs with a small fraction of life are excreted from the bodyin a short time. Such drugs are necessary to beit is often used to determine the required plasma concentrationlevels. The increase in dose frequency may decreasepatient compliance. This difficulty can be avoided bymaking drugs as a continuous release of the matrix typedrug delivery programs. [2]

The interview route is highly appreciated and comprehensive route adrug management. The route of oral administration hasused for both conventional and novel drug deliverysystem. In the present case, the measure form of continuous releasefails to use standard volume form. Ithe continuous release tablet provides the same drug releasefor a long time. Controlled output volumethe form includes a wide range of long actiona composition that provides for their continuous releasean active ingredient in a predetermined amount and time. Ongoing or controlled drug delivery program to reducefrequency of dosing or increasing efficiencyof the drug by making a place in the action area, reducing the doseneeded, to provide continuous drug delivery, reductionincidence of adverse effects and drug retentionto focus on the system. [3]

Matrix Drug Delivery System

These are the kind of controlled drug delivery systemsi releasing the drug in a continuous way for both of themdispersion is controlled and distribution is controlledmethods. Controlling drug release, whichthey have different melting points, the tree isdispersed in an inflamed hydrophilic substance, I an insoluble hydrophobic solid matrix that does not swellbuilding materials or plastic materials. [4]Introducing the matrix tablet as a continuous release (SR)provided a new approach to drug deliverysystem in the field of Pharmaceutical technology. Itdoes not include complex production processes such as coverageand pelletization during drug production and releasethe rate from the volume form is largely controlled bythe type and part of the polymer used in the preparation.Hydrophilic polymer matrix is widely usedto form an SR volume form. [5]Matrix systems are widely used for this purposecontinuous release. It is an extension programand controls the release of the dispersed drug orthey are scattered. In fact, the matrix is defined as well-mixeda combination of one or more drugs with a gelling agent i.e.hydrophilic polymers. In the form of continuous releaseeffective torture with treatment can be achievedin the system cycle for a long time, thus achieving better patient compliance. [6]

Advantage of matrix drug delivery system

1..Reduce negative local and systemic effects.

2. Flexible, efficient and low cost

3.Reduce toxicity by reducing drug absorption.

4.Reduce drug overdose by chronic dose.

Disadvantage of matrix drug delivery system

1.Not all drugs can be combined with a given polymeric matrix.

2.The remaining matrix must be removed afterThe tree is released.

3. Finding a zero order is difficult.

4. Drug release rates vary by square root oftime.

Matrix tablet

One of the cheapest ways tothe construction of controlled release volume forms involvesdirect compression of a drug compound, retardantmaterials and supplements to build a tablet therethe drug is embedded in the retardant matrix.On the other hand a combination of drugs and retardant may be granulatedbefore pressing.[7]

Classificationof matrix Tablet

Lipid matrix system: These matrices are fixed by lipid wax and are relatedbuilding materials. In this program the active combination iscontained in a time-consuming hydrophobic matrixdrug release. Exfoliation depends on the water contentto melt the track agent, leaking outcompact, so form a matrix with tortuous holescapillaries. The active agent dissolves in watermedium and, in the form of water filled capillaries,disperses outside the matrix.

Hydrophilic matrices: These transfer systems are also called swellable -soluble matrices. The systems are prone to inflammation,followed by gel formation, erosion and dispersionwater media. Components of hydrophilic colloidswell to form a layer of liquid matrix when in contact with itwater. This controls the further distribution of water in the middlematrix. Hydrated drug distributionmatrix layer controls the rate of release. OutsideThe hydrated matrix Layer will erode as it transforms morecleanse. The rate of erosion depends on the condition ofcolloid.

Polymergastrointestinal : The medicine in this approach is encased in an inert polymer that is not soluble in gastrointestinal fluids. Drug molecules in aqueous solution diffusing via a network of capillaries produced between compressed polymer particles determine the release rate. Changes in the porosity and tortuosity of an inert matrix can affect the pace at which a medication is released. Drug release will be heavily influenced by pore-forming hydrophilic salts or solutes.[8]

Biodegradable matrix system : The polymeric materials utilised in this sort of matrix system are monomers linked to each other by functional groups with instable functionality. Polymeric materials are broken down into oligomers and monomers using either biological enzymes produced by the surrounding tissues or non-enzymatic mechanisms. Proteins, polysaccharides, aliphatic polyesters, and polyanhydrides are examples of natural polymers used in this matrix base. Synthetic polymers include polyanhydrides.

Hydrophobic Matrices (Plastic matrices): The medicine is combined with an inert or hydrophobic polymer and crushed into a tablet in this method of generating sustained release from an oral dosage form. The dissolving medication diffuses through a network of channels between compressed polymer particles, resulting in sustained release. Polyethylene, polyvinyl chloride, ethyl cellulose, and acrylate polymers and copolymers have all been employed as hydrophobic matrices. In these formulations, liquid penetratioPhaephyceaen into the matrix is the rate-controlling step. Diffusion is a proposed mechanism for drug release in these types of tablets.[9]

Mineral Matrices [10]: These are made up of polymers derived from several seaweed species.Alginic acid, for example, is a hydrophilic carbohydrate produced by dilute alkali from brown seaweed species ().Based on the Porosity of the Matrix: The Matrix system canand are classified according to their porosity as wellas a result, Macro has holes; Micro porous as wellWaterless systems can be seen.

1.Macro Porous Systems

In such systems the distribution of the drug occursmatrix holes, which are 0.1 to 1 μm in size. Thispore size is greater than particle size separated.

2. Micro Porous System

Distribution on this type of system occurs basicallythrough the holes. In micro porous systems, pore sizedistance between 50 - 200 A °, slightly larger thanthe size of the dividing molecules.

3.Non-porous system

Non-porous systems have no pores and moleculeswe distributed them through network matches. In this case, onlythe polymeric phase is present and no pore phase is present.

Polymers Used In Matrix Tablet

1)Hydrogels

Cross-linked Polyvinyl Pyrrolidone (PVP)

Polyethylene oxide (PEO), Polyacrylamide (PA)

Cross-linked Polyvinyl Alcohol (PVA)

Poly Hydroxy Ethyle Methylacrylate (PHEMA)

2)Soluble polymer

Hydroxypropyl methyl cellulose (HPMC)

Polyvinyl Pyrrolidone (PVP)

Polyvinyl Alcohol (PVA)

Polyethylene Glycol (PEG)

3)Biodegradable polymer

Polycaprolactone (PCL)

Polyglycolic acid (PGA)

Polyanhydrides

Polylactic acid (PLA)

Polyorthoesters.[11]

4)Non-biodegradable polymer

Ethyl cellulose (EC)

Cellulose acetate (CA)

Polyvinyl chloride (PVC)

Polyether urethane (PEU)

Polyethylene vinyl acetate (PVA)

Polydimethylsiloxane (PDS)

5)Mucoadhesive polymer

Tragacanth

Polyacrylic acid

Sodium carboxymethyl cellulose

Polycarbophil

Methyl cellulose, Pectin.[12]

6)Natural gum

Karaya gum

Guar gum

Xanthan gum

Locust bean gum.[13]

Method of Preparation of Matrix Tablet

A. Wet Granulation Technique[9]

Milling and mixing of drug, polymer and excipients.

Preparation of binder solution.

Wet massing by addition of binder solution or granulating solvent.

Screening of wet mass.

Drying of the wet granules.

Screening of dry granules.

Blending with lubricant and disintegrant to produce “running powder”

Compression of tablet.

B. Dry Granulation Technique[14]

Milling and mixing of drug, polymer and excipients.

Compression into slugs or roll compaction.

Milling and screening of slugs and compacted powder.

Mixing with lubricant and disintegrant

Compression of tablet

C. Sintering technique[10]

The joining of neighbouring particle surfaces in a mass of powder, or in a compact, by the application of heat is referred to as sintering. Sintering is a process that involves heating a compact to a temperature below the melting point of the solid constituents in a controlled environment. The effects of sintering on the hardness and disintegration time of tablets held at high temperatures were studied. For the stabilisation and slowing of drug release, the sintering method has been used in the manufacture of sustained release matrix tablets.

MECHANISM OF DRUG RELEASE FROM MATRIX TABLETS[14]

Diffusion controlled

Drug in the outside layer exposed to the bathing solution is dissolved first and then diffuses out of the matrix. This process continues with the interface between the bathing solution and the solid drug moving toward the interior.[10]

It follows that for this system to be diffusion controlled, the rate of dissolution of drug particles within the matrix must be much faster than the diffusion rate of dissolved drug leaving the matrix. Derivation of the mathematical model to describe this system involves the following assumptions.[15]:

a) A pseudo-steady state is maintained during drug release.

b) The diameter of the drug particles is less than the average distance of drug diffusion through the matrix.

d) The bathing solution provides sink conditions at all times.The release behavior for the system can be mathematically described by the following equation:

$dM/dh = Co.\ dh - Cs/2$ …… (1)

Where,

dM = Change in the amount of drug released per unit area

dh = Change in the thickness of the zone of matrix that has been depleted of drug

Co = Total amount of drug in a unit volume of matrix

Cs = Saturated concentration of the drug within the matrix.

Additionally, according to diffusion theory:

$dM = (Dm.\ Cs / h)\ dt$..... (2)

Where,

Dm = Diffusion coefficient in the matrix.

h = Thickness of the drug-depleted matrix

dt = Change in time

By combining equation 1 and equation 2 and integrating:

$M = [Cs.\ Dm\ (2Co - Cs)\ t]\ ½$ …… (3)

When the amount of drug is in excess of the saturation concentration then:

$M = [2Cs.\ Dm.Co.t]\ 1/2$ …… (4)

Equation 3 and equation 4 relate the amount of drug release to the square-root of time.

Therefore, if a system is predominantly diffusion controlled, then it is expected that a plot of the drug release vs. square root of time will result in a straight line. Drug release from a porousmonolithic matrix involves the simultaneous penetration of surrounding liquid, dissolution of drug and leaching out of the drug through tortuous interstitial channels and pores.

[16,17]

The volume and length of the openings must be accounted for in the drug release from a porous or granular matrix:

$M = [Ds.\ Ca.\ p/T.\ (2Co - p.Ca)\ t]\ 1/2$ ……. (5)

Where,

p = Porosity of the matrix

t = Tortuosity.

Controlled drug delivery systems:

Controlled drug delivery systems have been created that can manage the pace of drug administration, maintain therapeutic activity for longer periods of time, and/or target drug delivery to a specific tissue. [18] Controlled drug delivery or modified drug delivery systems are categorised into four types for ease of use. 1) A postponed release 2) Consistent release 3) Targeting by location 4) Aiming at specific receptors Controlled delivery is defined as:[19] 1) Maintaining a reasonably steady, effective drug level in the body while minimising undesired side effects at a predetermined rate. 2) Drug delivery to

a specific target cell type via carriers or chemical compounds. 3) Develop a drug delivery system that is physiologically/therapeutically based.

Advantage of controlled drug delivery system [20]

1) Prevent issues with patient compliance.

2) Use a less amount of overall medication Minimize or eliminate side effects in the immediate area. Reduce, if not eliminate, systemic adverse effects. Chronic use results in reduced potentiation or a decline in pharmacological action.Chronic dosing helps to keep drug buildup to a minimum.

3) Increased therapeutic efficacy Improves the speed with which a problem is cured or managed. Improves condition control, i.e., medication level volatility is decreased. Some medications' bioavailability is increased. Sustained-release aspirin, for example, is used in the morning to relieve pain.Before going to bed, take a dose of arthritis medication.

Disadvantage of controlled drug delivery system

1)In the event of toxicity, poisoning, or hypersensitivity reactions, retrieving the medicine is challenging.

2) There is a need for more patient education and counselling.

3) Issues with stability.

4) The price has gone up.

5) More quicker tolerance and counselling development.

Factor affecting the design and performance of controlled drug delivery[18]

1. Drug properties

- Partition coefficient
- Drug stability
- Protein binding
- Molecular size and
- Diffusivity.

2. Biological properties

- Absorption
- Metabolism
- Elimination and
- biological half life
- Dose size
- Route of administration
- Target sites
- Acute or chronic therapy
- Disease condition

Mechanism of controlled drug release system

1.Diffusion Controlled System:

The diffusion process essentially depicts the migration of drug molecules from a higher concentration region to a lower concentration region. Fick's law describes the flow of the drug J (in amount / area -time) across a membrane in the direction of decreasing concentration.

$-D\, dc/dx = J$

Where D is the diffusion coefficient in area divided by time.

dc/dx denotes the change in concentration 'c' as a function of distance 'x'.

The release rate of a medicine is determined by its diffusion through an inert, water-insoluble membrane barrier in diffusion systems. Diffusion devices are divided into two categories.

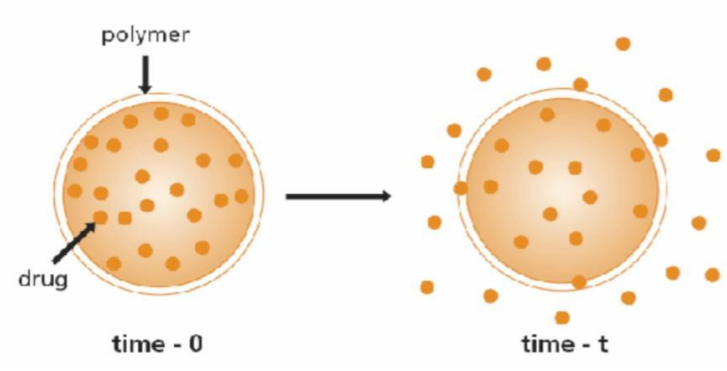

Fig 1: Schematic Representation of Reservoir

Reservior of type : A water-insoluble polymeric substance encases a drug core in the system, which regulates the pace of release. The drug will partition into the membrane and exchange with the fluid in the vicinity of the particle or tablet. More medication will enter the polymer, diffuse to the periphery, and exchange with the media. Ethyl cellulose and polyvinyl acetate are two polymers typically employed in these devices. [21]

Diffusion Controlled Drug Delivery Device : The level of the extracted drug (dm / dt) can becalculated using the following number

dm / dt = ADK ΔC / L

Where, A = Location,

D = Diffusion coefficient,

K = Partition coefficient of drug betweendrug and gastrointestinal tract,

L = Length of one-way distribution

ΔC = Concentration difference everywheremembrane.

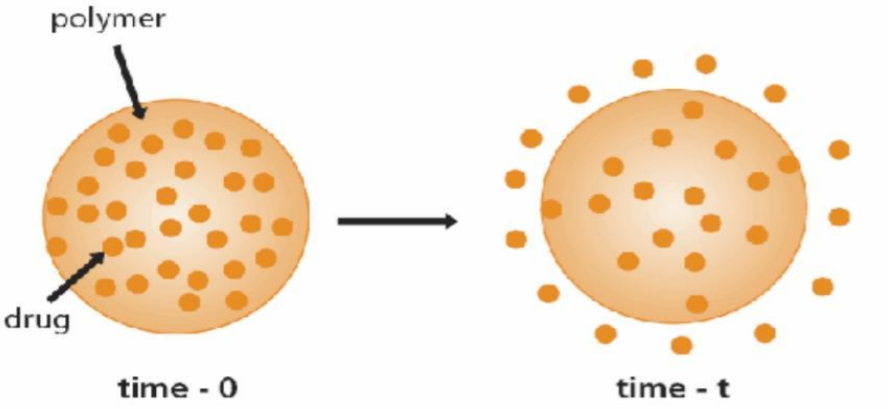

Fig 2: Schematic Representation of Monolithic (matrix) Diffusion Controlled Drug Delivery Device

Matrix type : Solid wood is dispersed in the same way in anInsoluble matrix and drug release ratedepending on the rate of drug distribution and not overthe level of solid finish.

Dissolution controlled system : Controlling the dissolving rate of drugs with a high water solubility and dissolution rate is difficult. Slowing the dissolving rate of a medication in the GI medium, corporating the drug in an insoluble polymer, and coating drug particles or granules with polymeric materials of varied thickness can all be used to achieve dissolution-controlled release. Diffusion over the aqueous boundary layer is the rate limiting stage in drug dissolution. Themedication's solubility provides a source of energy for drug release, which the stagnant-fluid diffusional barrier layer counteracts. The rate of dissolution (dm/dt) can be approximated as

dm/dt = ADS/h,

where S represents the drug's aqueous solubility.

A = Dissolving particle or tablet surface area.

D= diffusivity of the drug

h = Boundary layer thickness.

Conclusion : As a result of the above explanation, it is easy to deduce that controlled-release formulations aid in enhancing dose efficiency while also improving patient compatibility. Matrix tablets, which release drugs in a regulated manner, can be successfully prepared using matrix forming polymers. Preparatory procedures make it simple to tailor release kinetics to specific delivery requirements. The usefulness of matrix forming polymers in the production of diverse drug delivery systems underpins the significance of these specialised excipients in pharmaceutical applications.

Reference

1] Loyd V, Allen Jr, Nicholas G, Popvich, Howard C,Ansel. Ansel‟s Pharmaceutical dosage forms and drug delivery system. 8th ed., 2010; 260-263.

2. Yie W. chein , Yie. Novel Drug Delivery System, 1992.

3. Remington.the Science and practice of pharmacy, 20th ed., Lippincott Williams & Wilkins, 2002.

4. ME Aulton. “Pharmaceutics” The Science of dosage form design, 2nd ed., Churchill Livingstone, 2002.

5. Joshep R Robinson, Vincet H Lee. Controlled drug delivery, 2nd ed., Marcel Dekker, 1987; 4-15.

6. Altaf AS, Friend DR, MASRx and COSRx Sustained-release technology in modified release drug delivery technology, Marcell Dekker Inc., New York, 2003.

7.Borguist P, Korner A, Larsson A. “A model for the drug release from a polymeric matrix tablets-effect of swelling and dissolution”, Jourtnal of Controlled Release, 2006; 216-225.

8.Lee BJ, Ryu SG, Cui JH, Drug Dev. Ind. Pharm,1999; 25: 493-501.

9.Borguist P, Korner A, Larsson A. A model for the drug release from a polymeric matrix tablets-effectof swelling and dissolution, J Controlled Release, 2006; 216-225.

10. Tulsi Bisht, Poonam Rishiwer, Popin Kumar, Review On Matrix Tablet, Indo Global journal of pharmaceutical research, 2016; 6(1): 38- 42.

11. Chandran S, Laila FA and Mantha N, Design and evaluation of ethyl cellulose based matrix tablets of ibuprofen with ph modulated release kinetics. Indian Journal of Pharmaceutical Sciences, September-October, 2008.

12. Gothi GD, Parinh BN, Patel TD, Prajapati ST, Patel DM, Patel CN, Journal of Global Pharma Technology, 2010; 2(2): 69-74.

13. Basak SC, Reddy JBM, and Lucas Mani KP.Indian Journal of Pharmaceutical Sciences, September-October 2006.

14. Yang Shao, Liang Li, Xiangqin Gu, Linlin Wang, Shirui Mao, Evaluation of chitosan anionic polymers based tablets for extended- release of highly water soluble drugs, Asian journal of pharmaceutical sciences, 2015; 10: 24- 30.

15.B. Deepika, Samrin Begum, Faria Tahseen, D. Mounika, A Review on Matrix Tablet, European journal of Pharmacy and Pharmaceutical sciences, 2017.

16.Singh Surya Pratap, Soni Shankar Lal, Khinchi Mahaveer Prasad, A Brief Review on Sustained Release Matrix Tablets, International journal of Pharmaceutical Research, 2014; 146- 149.

17.A.Nokhodchi, Role of Controlled Release Matrix Tablet in Drug Delivery System, 2012.

18.Venkataraman DSN, Chester A, Kliener L.“An overview of Controlled release system” Handbookof pharmaceutical controlled release technology, 2000; 3(2): 1-30.

19.Loyd V. Allen. Jr, Nicholas G.Popvich, Howard C.Ansel. Ansel’s Pharmaceutical dosage forms and drug delivery system, 1994; 8(2): 260-263.

20.H.D.Zalte, R.B.Saudagar, “Review on sustained release matrix tablets”, International Journal of Pharmacy and Biological Sciences, 2013; 3(4): 17-29.

21.Allen, L.V., Popvich, G.N., & Ansel, H.C. Ansel’s Pharmaceutical dosage forms and drug delivery system. 2004.