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REVIEW ON –MATRIX TABLET AS A SUSTAINED RELEASE DRUG DELIVERY SYSTEM.

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ABSTRACT

The most popular method for administering different medications among all drug delivery systems is oral drug delivery. The aim of designing sustained delivery systems is to reduce the frequency of dosing or to increase the effectiveness of the drug by localizing at the site of action, reducing the dose necessary and providing uniform drug delivery. The most convenient and generally used method of drug delivery has always been oral ingestion .For oral Sustaine release dosage, matrix tablets are a key tool. By dispersing solid particles within a porous matrix made of hydrophilic and hydrophobic polymers, matrix tablets can be formed using wet granulation or direct compression techniques. Sustained release matrix tablets ensure consistent, prolonged drug release and increase drug bioavailability without causing unwanted side effects. The most crucial factor in the formulation of matrix tablets is now the availability of various classes of polymers for regulating the release of drugs.

Keywords: Sustained release drug delivery system, matrix tablet, Polymer

1. INTRODUCTION

The process through which a drug is released from a drug product and goes through absorption, distribution, metabolism and excretion before becoming available for pharmacological activity is known as drug release. (1)

Choosing the right medication is essential for maintaining a patient healthy in any disease or disorder state. To accomplish this, the drug or medicine is conventionally administered through one or more of several and so well drug administration routes. comprising topical, oral, parentral, rectal, alveolar, and ocular. (2)

Because of its ease in administration, patient compliance, and flexibility in formulation, oral drug delivery is the preferred route of drug delivery. Approximately 50% of the drug delivery systems available in the market are oral drug delivery systems. Sustained release Matrix tablets are used for the release of medication for a long period of time after administration of a single dose. (3)

The introduction of matrix tablets as sustained release (SR) has provided a new breakthrough in the field of pharmaceutical technology for novel drug delivery systems (NDDS). It excludes complex manufacturing procedures such as coating and pelletization, and the drug release rate from the dosage form is primarily controlled by the type and proportion of polymer used in the preparations. (4)

1.1 RATIONALE OF DEVELOPING SRDDS

1. Increase the medicine's duration of action.
2. Decrease the frequency of dose.
3. Minimize fluctuations in plasma level.
4. Improve drug use.
5. Reduce side effects.
6. Reduce the cost of treatment (5)

1.2 Principle of SRDDS

The active ingredients in conventional dosage forms are immediately released into an absorption pool. This is depicted in the simple kinetic scheme below. The absorption pool represents a drug solution at the absorption site, and Kr, Ka, and Ke are first order rate constants for drug release, absorption, and overall elimination, respectively. The fact that a conventional dosage form produces immediate drug release implies that Kr>>>>Ka. KrKa, or drug release from the dosage form, is the rate limiting step for non-immediate release dosage forms.

The drug should be released from the dosage form using zero-order kinetics, as shown by the following equation:

Kr° = Rate In = Rate Out = Ke .Cd.Vd

Where;

Kr°: drug release-Amount/time zero-order rate constant.

Ke: Overall drug elimination time first-order rate constant

Cd: Amount/Volume of the desired drug level in the body

Vd: volume space in which the drug is dispersed. (6)

1.3ADVANTAGES OF SUSTAINED RELEASE DRUG DELIVERY (7)

1. Reduced dosing frequency of intakes.
2. Potent drug's safety margin has been increased.
3. Drug release is uniform over time.
4. Reduced variability in steady-state drug levels.
5. The drug should be used to its full potential.
6. Reduce the number of side effects.
7. Improved patient compliance.
8. Reduce fluctuations in plasma level.
9. Drug administration can also be made more convenient.
10. To prolong the duration of the drug's action.
11. Avoidance of nighttime dosing. (8)

1.4 DISADVANTAGES OF SUSTAINED RELEASE DRUG DELIVERY

1. delay in the onset of the drug's effects. (9)
2. The formulation is expensive
3. Toxicity due to dose dumping.
4. Enhance the potential for first-pass metabolism.
5. Poor in vivo-in vitro correlations (IVIVC)

6. Drugs that are normally administered in varying strengths have a lower potential for dosage adjustment.
7. In cases of toxicity, drug retrieval is difficult. (10)

1.5 Classification of Sustained release drug delivery system

The classifications can be applied to this system depending on how the drug is released:

A.Continuous Release system

a) Diffusion sustained system

1. Matrix type
2. Reservoir type

b) Dissolution sustained system

1. Matrix type
2. Reservoir type

c) Methods using Ion-exchange

d) pH independent formulations

e) Altered density formulations

f) Methods using osmotic pressure

B. Delayed Transit and Continuous Release System

C. Delayed Release System (11)

A. Continuous release system

a. Diffusion controlled system

1. **Reservoir devices**

A membrane in this system regulates the release of medicines from the matrix system.

Reservoir diffusion systems have the following characteristics:

1. It is possible to release drugs in zero orders.
2. According on the type of polymer, the release rate varies.
3. Delivering high molecular weight compounds through the device is difficult.

2. **Matrix type**

The distribution of a solid drug into an insoluble matrix and the rate of drug release are typically influenced by drug diffusion and solid dissolution rates.

The characteristics of the Matrix type

1. Zero order release can not be obtained.
2. simpler to produce than reservoir devices
3. The device is used to deliver high molecular weight compounds

b. Dissolution controlled Release system

Drugs with a slow rate of dissolution are maintained naturally, and those with a high degree of water solubility can be made to dissolve more slowly by forming the appropriate salts or derivatives.

Soluble reservoir system

the drug has an erodible coating that is alternated with rate-regulating coats to slowly dissolve in the contents of the GI tract.

Soluble matrix system,

this system is also called monolithic system As the drug is homogenously dispersed throughout rate controlling medium.

C. Methods using Ion-exchange

Since drug release characteristics are largely dependent on the ionic environment of resins containing drug and are less sensitive to environmental factors like enzyme content and pH at the absorption site, using ion exchange resin is an attractive method for sustained drug delivery. release of zero orders with this method, kinetic can be achieved satisfactorily. (12)

d. pH– Independent formulations:

Most of the drugs are weak bases or weak acids. drug release from a sustained release formulation depends on the pH. The formulation may contain buffers, such as salts of amino acids, citric acid, phthalic acid, phosphoric acid, or tartaric acid, to help maintain a constant pH and make drug release pH independent. A basic or acidic drug is typically combined with one or more buffering agents, then the mixture is granulated with the proper pharmaceutical excipients before being coated with a gastro-intestinal fluid permeable film forming polymer. The buffering agents adjust the fluid inside to a suitable constant pH when gastrointestinal fluid permeates through the membrane, resulting in a constant release rate of drug. (12)

e. Altered density formulations

A dosage form has a limited use if all of its components are not absorbed by the GI tract. To this end, a number of strategies have been developed to extend the residence time of drug delivery systems in the digestive system. (12)

High density approach

Low density approach

f. Methods using osmotic pressure

The tablet, particle, or drug solution is surrounded by a semi-permeable membrane that permits water to enter the tablet and eventual pumping of the drug solution out of the tablet through the small delivery aperture in the tablet core.includes a drug-containing osmotic core and has a flexible bag that the drug is contained in with an osmotic core around it. (13)

B. Delayed Transit and Continuous Release System

These systems are designed to prolong both their release from the GI tract and their Residence there. Since the dosage form is frequently designed to remain in the stomach, the drug inside should be stable to gastric pH. This category includes systems like size-based systems and mucoadhesive systems. (13)

C. Delayed release systems:

Such systems are designed to release the drug only at a specific place in the GIT. Drugs that are known to cause gastric distress and those that are destroyed in the stomach or by intestinal enzymes are included in such a system. (13)

1.6 FACTORS AFFECTING SUSTAINED RELEASE DRUG DELIVERY SYSTEM

1.6.1 Biological factors (14)

1. First pass effect

Drugs with a significant first pass effect have a slower release rate. This slower release rate has an affect on bioavailability.

2. Half life

The period of a drug's residence in the body is measured by its half-life. The dose form may have an unreasonably high concentration of the medicine if the medication has a short half-life (less than 2 hours). The body can effectively sustain a medication with a half-life of removal of eight hours or longer, however, when it is given in conventional doses and using continuous drug delivery systems.

3. Adverse effects

Drug release that is prolonged may result in undesirable side effects.

4. Absorption and solubility

Solubility and absorption are related concepts. Reduced overall absorption efficiency may be caused due to the incorporation of drugs with poor water solubility.

1.6.2 Physiochemical Factors

1. Aqueous solubility & Pka

A medication that will be absorbed, dissolved, and partitioned into the absorbing membrane in the aqueous phase adjacent to the route of administration site. The water solubility and, if it is soft acid, the pKa of a drug are two of the most significant physicochemical characteristics that influence its absorption activities. Controlled release techniques are successful because of these characteristics. Drugs with high water solubility degrade slowly and are frequently causing issues with oral bioavailability.

2. Diffusivity and molecular size

The diffusivity is influenced by the size and form of the membrane cavitie. The flexible polymer array contributes to the 100–400 Daltons, or 10–6–10–9 cm2/sec, intermediate molecular weight drug diffusion coefficient. For medications with molecular weights greater than 500 Daltons, many polymers have very low diffusion coefficients, or less than 10–12 cm2/sec. Drugs that are challenging to control drug release level from dosage form include proteins and peptides.

3. Drug stability

Acid-base hydrolysis and enzymatic degradation occur when medications are taken orally. A drug release system that delivers medication over an extended period of time is preferred in this situation if the drug is unstable in the stomach. In contrast, a drug that is unstable in the intestine will have problems with bioavailability. (15)

4. Partition coefficient

The partition coefficient is a critical parameter when designing extended release dosage forms. The partition coefficient is higher for the approximately predominantly lipid soluble and easily absorbed through the membranes, resulting in greater bioavailability. The low partition co-efficient is unsuitable for designing dosage farms. This results in low bio availability. (16)

1.7 DRUG SELECTION FOR SUSTAINED RELEASE DRUG DELIVERY SYSTEM

For the selection of a drug to be formulated in sustained release dosage form, there are various physiochemical and Pharmacokinetic parameters.

Table 1.7.1 physicochemical parameters of drug selection (17)

parameter	**preferred value**
molecular weight	<1000 daltons
solubility	>0.1 mg/ml for ph 1 to ph 7.8
apparent partition coefficient	high
absorption mechanism	diffusion
general absorbability	from every gi segment
release	should not be influenced by ph and enzymes

Table 1.7.2 pharmacokinetic parameters for drug selection (17)

parameters	**comment**
elimination half-life	preferably between 2 to 8
elimination rate constant	required for design
total clearance	should not be dose dependent
apparent volume distribution (veda)	the larger veda and mec, the larger will be the required dose size
absolute bioavailability	should be 75% or more
therapeutic concentration	the lower cuss and smaller veda loss among the dose required
toxic concentration	apart the values of mtc and mec, safe the dosage form. also suitable for drugs with very short half life

2 Matrix tablets

Direct compression of the drug, release retardant, and additives to producing a tablet with the drug embedded in a matrix core of release retardant is one of the simplest methods for producing sustained release dosage forms. An alternative is to granulate the drug retardant mixture before compression. These are referred to as matrix tablets. (18)

2.1 CLASSIFICATION OF MATRIX TABLETS

2.1.1 On the Basis of Retardant Material Used: Matrix tablets can be divided in to 5 types.

1. Hydrophobic Matrices (Plastic matrices)

In this method, a drug is mixed with a hydrophobic or inert polymer and compressed into a tablet to achieve a sustained release from an oral dosage form. Sustained release is achieved because the dissolving drug diffuses through

a network of channels that exist between compacted polymer particles. Although insoluble polymers have been used, this is the only system in which the use of a polymer is not required to provide controlled drug release. (19)

2. Lipid Matrices.

Lipid waxes and other materials are used to prepare these matrices. Drug release from such materials occurs via pore diffusion as well as erosion. As a result, release characteristics are more sensitive to digestive fluid composition than to completely insoluble polymer matrix. (19)

3. Hydrophilic Matrices

Because of their flexibility in obtaining a desirable drug release profile, cost effectiveness, and broad regulatory acceptance, hydrophilic polymer matrix systems are widely used in oral controlled drug delivery. In the field of controlled release, there is particular interest in the formulation of medications using hydrophilic polymers with high gelling capacities as the base excipients to create gelatinous capsules or, more frequently, tablets. Actually, the definition of a matrix is a thoroughly combined mixture of one or more drugs and a gelling agent (hydrophilic polymer). (20)

4. Biodegradable Matrices

These are consisted of polymers with unstable backbone linkages made up of monomers connected to one another by functional groups. By means of enzymes secreted by nearby living cells or through nonenzymatic processes, they are biologically eroded or degraded into oligomers and monomers that can be metabolised or excreted. Examples include synthetic polymers like aliphatic poly (esters) and poly anhydrides, as well as natural polymers like proteins and polysaccharides, as well as modified natural polymers. (21)

5. Mineral Matrices

These are made up of polymers obtained from various seaweed species. Alginic acid, for example, is a hydrophilic carbohydrate obtained from brown seaweeds (Phaephyceae) using dilute alkali. (21)

2.1.2 **On the basis of porosity of matrix**

a) Macroporous systems

This type of matrix has pores that are between 0.1 and 1 m in size, which is larger than diffusion molecules. This type of system allows the drug to permeate through these pores. (22)

b) Microporous systems

Drug molecules pass through pores with sizes ranging from 50 to 200 Å .(22)

c) Non-porous systems

No pores exist in these systems. Molecular diffusion takes place through network meshes. Where the polymeric phase is present, there is no pore phase. (22)

2.2 Mechanism of drug release from matrix tablet:

Drug present in the outer layer exposed to the aqueous solution is dissolved first and then diffuses out of the matrix. The interface between the bathing solution and the solid drug is still moving inward during this process. As a result, for this system to be diffusion controlled, the rate of drug particle dissolution within the matrix needs to be much faster than the rate of drug dissolution outside the matrix.

Following assumptions apply to this system:

a) The drug release is maintained in a pseudo-steady state,

b) The drug particle diameter is smaller than the typical drug diffusion through the matrix distance.,

c) The bathing solution always provides sink conditions. (23)

2.3 Methods of Preparation of Matrix Tablet

1. Direct Compression

Finely powdered materials are compressed directly without affecting the drug's physical and chemical properties. (24)

2. Wet Granulation method

Weighed quantities of drug and polymer are combined with an appropriate volume of granulating agent. After achieving sufficient cohesiveness, the mass is sieved, dried at 40°C, and stored in a desiccator. Lubricants and glidants are added before the tablets are compressed on a tablet compression machine. (25)

3. Melt Granulation Method

Since meltable substances serve as the liquid binding agent in melt granulation, organic solvents are not necessary. This substance can be poured over the substrate while it is still molten and then heated to a temperature above its melting point. In the melt granulation technique, a variety of lipophilic binders, including glyceryl palmitostearate, are used. (25)

2.4 POLYMERS USED IN MATRIX TABLETS

Hydrogels

Polyhydroxyethylemethylacrylate (PHEMA),

Cross-linked polyvinyl alcohol (PVA),

Cross-linked polyvinyl pyrrolidone (PVP),

Polyacrylamide (PA),

Polyethylene oxide (PEO)

Soluble polymers

Polyethylene glycol (PEG),

polyvinyl alcohol (PVA),

Polyvinylpyrrolidone (PVP),

Hydroxypropyl methyl cellulose (HPMC)

Biodegradable polymers

Polyglycolic acid (PGA),

Polycaprolactone (PCL),

Polyanhydrides,

Polyorthoesters ,

Polylactic acid (PLA)

Non-biodegradable polymers

Polyethylene vinyl acetate (PVA),

Polyether urethane (PEU),

Polyvinyl chloride (PVC),

Cellulose acetate (CA),

Ethyl cellulose (EC),

Polydimethylsiloxane (PDS).

Mucoadhesive polymers

Sodium carboxymethyl cellulose,

Polycarbophil,

Polyacrylic acid,

Tragacanth,

Methyl cellulose,

Pectin,

Natural gums

Guar gum,

Xanthan gum,

Karaya gum,

Locust bean gum

Gum Arabic. (26)

2.5 Description of Polymers

Cross-linked Polyvinyl Alcohol

It is a hydrophilic polymer. It acts as hydrogel. The rate of drug release from hydrogel is regulated by cross-linking density and the extent of swelling; the entrapped drug with in the swelling matrix concomitantly dissolves and diffuses through the swollen network into surrounding aqueous environment. it releases the drug with a relatively high rate. (27)

Polyacrylic Acid

It is belonging to the chain growth polymerization category and is also referred to as polyacrylates and polyacrylates elastomers. The unique property of polyacrylic acid is that at pH 5, it is a liquid, and at pH 7, it is a gel. Polyacrylamide serves as a support matrix for the immobilisation of the functional components or ligands in an extracorporeal toxin removal modality. (27)

Xanthum Gum

Based on the nature of polymer-water interaction Xanthan Gum is a hydrophilic polymer that is derived from the bacterial coat of Xanthomonas campestris and is used as a food additive and rheology modifier. Xanthan Gum has

also been used to produce directly compressed matrices with a high degree of swelling due to water uptake and a minor amount of erosion due to polymer relaxation. It has also been used in the preparation of sustained-release matrix tablets with Chitosan, Guar Gum, Galactomannan, and Sodium Alginate. Xanthan Gum has been used as a binder. (27)

Guar Gum

According to the nature of polymer-water interaction Guar Gum is a polymer that is hydrophilic. Galactosol and Guar flour are other names for it. It is used as a binder and disintegrant in solid dosage forms, as a suspending, thickening, and stabilising agent in oral and topical products, and as a controlled-release carrier. It has also been investigated as a substitute for cellulose derivatives such as methylcellulose in the preparation of sustained-release matrix tablets. Three-layer matrix tablets based on guar gum have been tested in oral controlled-release formulations. (27)

Ethyl Cellulose

Ethyl Cellulose is also known chemically as Cellulose Ethyl Ether. Ethyl Cellulose is a coating, flavouring, tablet binder, tablet filler, and viscosity increasing agent. It i is non-toxic, stable, compressible, inert, and hydrophobic. For both soluble and poorly soluble drugs, film coated tablets, microspheres, microcapsules, and matrix tablets are used in sustained release products. Ethyl Cellulose acts as an inert, hydrophobic matrix, it produces hard tablets with low friability, which typically disintegrate easily. This can be advantageous for delaying the release of drugs that are soluble in water. (27)

Hydroxy Propyl Methyl Cellulose

It is the foundation of sustained release hydrophilic matrix tablets. In solid dosage forms, Hydroxypropyl Methyl Cellulose is used as an enteric film coating material or as a matrix binder. Because of its non-toxic nature, easy compression, swelling properties, and accommodation for high levels of drug, 10-80% w/w Hydroxyl Propyl Methyl Cellulose is used to retard the release of drugs from oral delivery systems. (27)

Pectin

Pectin is a hydrophilic polymer based on the nature of the polymer-water interaction. Pectin also has several distinct properties that allow it to be used as a matrix for the entrapment and/or delivery of a variety of drugs, proteins, and cells. In the food and beverage industries, pectin has been used as a thickening, stabilising, and gelling agent stabiliser. It has been used in the formulation of controlled-release matrix tablets. (27)

Polyethylene Oxide

According to the nature of the polymer-water interaction Hydrophilic polymers include polyethylene oxide. It is also called to as Polyox.Matrix materials are made of polyethylene oxide. Extremely high molecular weight Polyethylene Oxide successfully delayed the rate of release of soluble and insoluble drugs from matrix tablets prepared through direct compression. It's also a mucoadhesive polymer. (27)

Ceratonia (Locust Bean Gum)

Ceratonia is a hydrophilic polymer based on the nature of polymer-water interaction. It is also known to as Algarroba or St. John's bread. Ceratonia is a naturally occurring material that is commonly used as substitute for Tragacanth and other similar gums. Ceratonia is five times more effective than starch and twice as effective as Tragacanth as a viscosity-increasing agent. Ceratonia has also been used as a tablet binder and in controlled-release drug delivery systems for oral administration. (27)

Polyether Urethane

It is a non-biodegradable polymer based on degradability. Polyether Urethane is a polymer made up of a chain of organic nodes linked by carbamate (urethane) links. it Used in a controlled drug delivery system. (27)

Tragacanth

It is derived from the Astragalus gummifer's branches. Leguminosae family

When Tragacanth used as the carrier in the creation of 1- and 3-layer matrices, either alone or in combination with other polymers, produced satisfactory release prolongation. (27)

Poly (ethylene glycol) (PEG)

Polyethylene glycol is synthesized by the interaction of ethylene oxide with water, ethylene glycol, or ethylene glycol oligomers. When conjugated with hydrophobic drugs or carriers, PEG's high hydrophilic nature improves their solubility. (28)

Polyvinylpyrrolidone (PVP)

It is a water-soluble polymer with a molecular weight that ranges from 40,000 to 360,000. It is synthesized by polymerization of vinylpyrrolidone in isopropanol or Water. It is primarily utilised in tablet formulations as a binder. Wet granulation with PVP that has a molecular weight between 25,000 and 90,000 typically results in harder granulates with good flowability, higher binding, and lower friability when compared to other binders. (28)

Polyvinyl alcohol (PVA)

PVA is soluble in highly polar and hydrophilic solvents like water, DMSO, EG, and N-Methyl Pyrrolidone. The solubility, surface tension, and viscosity of PVA depend on concentration, % hydrolysis, molecular weight and temperature of the material. (28)

Polyacrylamides

It is a synthetic polymer derived from acrylamide monomer that was first used as a support matrix for electrophoresis in 1959. Polyacrylamide is a polymer composed of acrylamide units. a neurotoxin. However, polyacrylamide is not toxic in and of itself, but it is a contentious ingredient due to its potential to secrete acrylamide. (28)

Sodium carboxymethyl cellulose,

It is a preferred polymer because it has a variety of functional properties such as thickening, binding and stabilising agents. (28)

2.6 Different drugs and polymers used in sustained- release Matrix tablets

Table 2.6: - drug and polymer used in matrix tablet

drug	**polymer**	**ref**
metoclopramide hydrochloride	hydroxy propyl methyl cellulose (hpmc), carboxymethylcellulose (cmc), ethyl cellulose (ec)	29
tramadol hydrochloride	xanthan gum, guar gum	29
tramadol hydrochloride	hpmc k15, karaya gum	29

aceclofenac	carbopol 971p	29
zidovudine	hpmc-k4m, carbopol-934, ec	30
domperidone	hpmc-k4m, carbopol-934	30
alfuzosin	hpmc-k15m, eudragit-rspo	30
metformin hcl	hpmc-k100m, ec	30
acarbose	hpmc, eudragit	30
ambroxol hcl	hpmc-k100m	30
diclofenac na	chitosan, ec, hpmcp, hpmc	30
diethylcarbamazepine citrate	guar gum, hpmc-e15lv	30
enalpril meleate	hpmc-k100m, hpmc k4m	30
flutamide	hpmc-k4m, sod.cmc, guar gum, xanthan gum	30
itopride hcl	hpmc-k100m, hpmc-k4m, ec	30
miconazole	pectin, hpmc	30
nicorandil	hpmc, cmc, ec	30
phenytoin na	tragacanth, acacia, guar gum, xanthan gum	30
tramadol	hpmc-k4m, karaya gum, carrageenam gum	30
albuterol	hpmc-k100m, hpmc-k4m, hpmc-k15m, ec,xanthan gum, gaur gum	30
ibuprofen	cellulose acetate phthallate, ethyl cellulose	31
tramadol hydrochloride	carrageenan gum, karaya gum, hpmc k15	31
metoprolol succinate	hpmc k100m, xanthan gum	31
ambroxol hydrochloride	hpmc	32
tramadol hydrochloride	xanthan gum, guar gum.	32
aceclofenac	carbopol 971p, carbopol	32
venlafexine	beeswax, caranuaba wax	33
minocycline	hpmc-k4m, hpmc-k15m, ec	33
propranolol hcl	locust bean gum, hpmc	33
furosemide	guar gum, pectin, xanthan gum	33
aceclofenac	hpmc-k4m, k15m, k100m, e15, ec, guar gu	33
aspirin	ec, eudragit-rs100, s100	33
diltiazem	hpmc-k100m, hpmc-k4m, karaya gum, locust bean gum, sod.cmc	33

enalpril meleate	hpmc-k100m, hpmc k4m	33
indomethacin	ec, hpmc	33
chlorpheniramine maleate	xanthan gum, chitosan	33
losartan potassium	hpmc-k100m, hpmc-k4m, eudragit-rspo	33
metoclopramide	hpmc, cmc, ec, ssg	33
naproxen	hpmc-k100m, hpmc-k15m, pvp	33
ondansetron	hpmc-k100m, hpmc-k4m, hpmc-k15m	33
ranitidine hcl	chitosan, carbopol-940	33
theophylline	carbopol-934p, hpmc-k100m, hpmc-k4m, hpmc-k15m, ec	33
verapemil	hpmc-k100m, hpmc-k4m, hpmc-k15m	33
amlodipine	hpmc, ec	
ambroxol hcl	methocel k15mcr, pvp k30	34
metformin hydrochloride	chitosan, ethyl cellulose hpmc, xanthan gum	34
cefpodoxime	hpmc(k4m), hpmc(k100m) and xanthan gum	34
risperidone	hpmc (k100), hpmc (k4m), xanthan gum	34
lamivudine	hpmc(methocel k15m cr) avicel 102	34
isoniazide	guar gum, tragacanth gum peg-6000	34
terbutaline sulphate	hpmc k200m, ethyl cellulose	34
indomethacin	hibiscusrosa-sinensis, microcrystalline cellulose, magnesium stearate	34
nateglinide	xanthan gum, guar gum	34
zidovudine	hpmc, xanthan gum, ethyl cellulose	34

2.7 EVALUATION OF MATRIX TABLETS

2.7.1 Pre compression characterization

1.Angle of Repose: (35)

The angle of repose determined using the fixed funnel method. The angle of repose calculate using following formula.

Tanq = h/ r

Where,

h = Pile Height,

r = Radius of Pile

2.Bulk Density:(35)

Bulk Density (Db) It is a ratio of mass of powder to bulk volume. The bulk density depends on particle size distribution, shape and cohesiveness of particles. Accurately weighed quantity of powder carefully poured into graduated measuring cylinder through large funnel and volume measured, which is the initial bulk volume. Then it is expressed in gm / mL and is given by

Db = M / V0

Where,

M = mass of powder

V0 = bulk volume of the powder

3.Tapped Density: (35)

10 gram of powder is introduced into a 100 mL measuring cylinder. Then cylinder is tapped 100 times a constant height and the tapped volume is measured.

Dt = M / Vt

Where,

M = mass of powder

Vt = tapped volume of the powder

4.Carr's Compressibility Index: (36)

This is a significant measure that can be easily obtained from bulk density determinations. The Carr's Index parameter can be calculated using the following formula

Carr’s index percentage = tapped bulk density (TBD) –loose bulk density (LBD)/tapped bulk density (TBD) x 100

5.Hausner’s Ratio (36)

Hausner ratio is an indirect type index for measuring the powder flow character. It is widely used for calculated by this following formula

Hausner ratio’s ratio = tapped density (TD)/ bulk density (BD)

2.7.2 Post Compression Characterization:

1.Hardness Test : Tablets must be hard enough to withstand mechanical shock during manufacturing, packaging, and shipping. As a result, hardness is sometimes referred to as tablet crushing strength. Hardness is measured with the help of Monsanto tester (37)

2.In- Vitro Drug Release profile: The in vitro drug release profile of a matrix tablet is determined using a USP dissolution apparatus type 2. In general, a single matrix tablet is placed in a dissolution flask containing 900 ml of dissolution medium. The flask is kept at $37^0c \pm 0.5^0c$ C by a constant temperature bath. The motor is set to turn at the specified speed (50 rpm), and fluid samples are drawn at regular intervals to determine the amount of drug in the solution. When compared to conventional tablets, matrix tablets slowly release the drug over a longer period of time. (37)

3.Uniformity of Weight: Using an analytical balance, weigh 20 tablets separately. The weight variation should be kept within the limits specified. If more than two tablets are not within the specified ranges, the test will fail. (38)

4.Thickness: Three tablets is selected randomly from each batch. thickness is measured by using Vernier Caliper. (39)

5.Friability: The friability of the tablet determined using the Roche friabilator. This device show the tablet is combined effect of abrasion and shock in a plastic chamber revolving at 25 rpm and tablet is drop at a height of 6 inches in each revolution. Pre weighed sample of tablets is placed in the friabilator and subjected to the 100 revolutions. Tablets is dusted using a soft muslin cloth and reweighed. (39)

Conclusion

This review article has a special focus on sustained release drug delivery system its advantages and disadvantages. sustained-release formulation are helpful in increasing the efficiency of the dose as well as they are also improving the patient's compatibility. More over all these comes with reasonable cost. The main focus of this review article has been helpful for the formulation of sustained-release matrix tablets, and factor affecting the dosage form, criteria for selection of drug for sustain release delivery and various polymers used to design such system.

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