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AN OVERVIEW ON MATRIX TABLETS

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ABSTRACT:

In many drug delivery systems that use controlled release, matrix tablets are used. Controlled release matrix tablets promote stability by shielding the active ingredient from hydrolysis and degradation and improve patient compliance by reducing dose frequency. It uses either a diffusion control mechanism or a dissolution control mechanism to release pharmaceuticals at a defined and predicted pace in a regulated way. The rate-controlling agent, or polymers, which might be hydrophilic, plastic, lipidic, or mineral, evenly disperses the active ingredient. The polymer slows down the rate of release. As a result, it regulates drug blood levels at a consistent therapeutic level, avoids volatility, and guards against systemic or localised adverse responses.

KEY WORDS:

Matrix tablets, controlled release, Polymers, Production methods.

INTRODUCTION:

Many researchers were interested in drug delivery systems (1,2). The oral route is the best for administering medications. In order to increase patient compliance, numerous oral dose forms have been created to date. Drugs that have a shorter half-life leave the body faster. In order to achieve the necessary plasma levels, these medications must be taken repeatedly. The patient compliance may decline if the dose frequency is increased. The ideal option for drug delivery systems is to provide the medications as a matrix type sustained-release to address this issue (3).

The most stable dosage forms to increase a drug's bioavailability are sustained dose forms. By creating a matrix there, these dosage forms release the medication and enable total solubility and absorption from the intestinal mucosa. These dosage forms are made with rate-delaying polymers, which upon hydration create a network-like matrix (4). Due to their ability to withstand an acidic environment, dosage forms of the matrix type can also preserve medications that are sensitive to the stomach environment. The medicine must be released at a predetermined amount and dissolve in gastrointestinal fluids in order to produce an effective sustained release product. Sustained-release drug delivery system formulations aim for ideal release rates, less daily dosage needs, better adsorption, and reduced side effects (5).

Controlled Drug Delivery Systems

- Controlled drug delivery which delivers the drug at predetermined rate, for locally orsystemically for a specific period of time
- Continuous oral delivery of drugs at predictable and reproducible kinetics for predeterminedcourse throughout the GIT (6).

Potential advantages of sustained drug therapy

1. Prevent issues with patient compliance.

2. Use less medication overall.

A. Reduce or get rid of local side effects.

B. Reduce or get rid of systemic side effects.

C. With prolonged use, the potency or activity of the drug is reduced.

D. Reduce drug buildup with persistent dosage.

3. Increase treatment effectiveness

A. A faster recovery from the controlled state B better control of the condition, i.e., less medication level fluctuation.

B. Enhance the bioavailability of some medications

C. Use unique effects, such as sustained-release aspirin for arthritic relief by taking a dose before bed.

4. Economy (7).

Matrix systems

A homogenous system known as a matrix system has been created by combining a polymer and an active ingredient. Hydrophobic and hydrophilic matrices have been utilised to regulate the drug's release since they have different solubility properties (8).

For medications that are soluble in water, a mixture of hydrophobic and hydrophilic polymeric matrices is used. The design of oral controlled drug matrix systems is influenced by the drug's physicochemical qualities, which are listed below.

1.Partition coefficient

2. molecular weight

3. solubility.

4.Pharmacological stability and

5. protein binding (9).

Production methods for matrix tablets:

Direct compression:

physically compressing powders or grains into tablets without changing their physical properties.

Dry granulation:

There are two varieties: roller compaction and slugging. Granules are recompressed and slugs are crushed to create granules using the slugging method. As opposed to roller compaction, which uses pressure rolls to recompress the powder.

Wet granulation:

It entails mixing dry granule blends in a volatile fluid, followed by wet sizing, drying, and dry screening (10).

Steam granulation:

Instead of using water, steam serves as the granulation's binder. It diffuses and spreads evenly throughout the granules. More surface area causes the granules to become rounded, which increases the pace at which drugs dissolve from granules.

Melt granulation:

Granulation, which melts at 50–80 °C, uses moldable binders. Dry granules were gathered when it was cooled to room temperature (11).

Freeze granulation:

Spraying slurry into liquid nitrogen causes droplets to instantly freeze into granules, which is followed by the drying process known as lyophilization.

Foam granulation:

Aqueous binders are added as foam, increasing the foam's surface area and enhancing the diffusion of water in the powder bed (12).

Sintering method:

Powder compact heated in a controlled atmosphere at atmospheric pressure to a temperature below the melting point of solid particles(13).

matrix system types:

Depending on the type of retarding agents or polymeric materials used, the matrix system can be categorized into five categories .

1.system with hydrophilic matrix.

2.system with a hydrophobic matrix.

3.system made of fat- wax.

4.systems with biodegradable matrix.

5.mineral matrix (14).

1.systems with hydrophilic matrix:

Swellable controlled release matrices is another name for it. Due to its affordability and versatility, hydrophilic matrix is frequently employed in the production of customised release delivery systems. Drug and hydrophilic polymer are uniformly dispersed in matrix tablets, which serve as gelling agents. Because polymers may absorb liquids from the GI tract and create 3-D structures,(15) the release of medication from matrix tablets is controlled. The expansion and corrosion of the gel, which regulates the release of the drug, causes the drug to be released from the gel barrier. The system's drug release kinetics are influenced by the chemistry, density, and strength of the polymers. It has been used to control the rate at which drugs with various aqueousities release(16).

2.Systems of hydrophobic matrix:

It also goes by the name of plastic matrices. Drugs are granulated into matrix tablets utilising hydrophobic polymers and latex or pseudo-latex. Polyethylene, polyvinyl chloride, ethyl and methyl cellulose, cellulose acetate, polystyrene, latex, and carbomers are a few examples of hydrophobic polymers. In hydrophobic matrices, the rate-limiting component is insoluble in water. Drug diffusion across the matrix maintains controlled release(17).

Fluid invasion in the matrix is the system's rate-limiting stage. During drug release, insoluble matrix system components keep the matrix structure intact. A drug's release profile can be changed by include soluble excipients in the matrix, such as lactose. Due to constant molecular diffusion and a limited release profile, insoluble medicines are not ideal candidates for hydrophobic matrix.

3.systems made of fat-wax:

Fluid invasion in the matrix is the system's rate-limiting stage. During drug release, insoluble matrix system components keep the matrix structure intact. A drug's release profile can be changed by include soluble excipients in the matrix, such as lactose. Due to constant molecular diffusion and a limited release profile, insoluble medicines are not ideal candidates for hydrophobic matrix.

The term "lipid matrix system" refers to it. It is made of a lipid compound or waxy fat. Through the whole out time range, the drug release from the matrix is constant. The liberation of active substances depends on fluid media that is integrated into the matrix-forming agent and would leach out from the compact mass to produce a porous matrix of twisted tubing (18). Both porous diffusion and erosion mechanisms are viable options for this matrix's drug release. The matrix included water-filled tubes through which drugs were dispersed in dissolving media. Surfactant incorporation in the system can also affect the pattern of release & the percentage of total active substances inside the matrix. Granules can be created from drugs and other excipients such as waxes and diluents by compacting, drying, mixing, and granulating (19).

4.Systems with biodegradable matrix:

Monomers in this matrix are linked together by weak bonds to form polymers, which can break down or dissolve by enzymatic or non-enzymatic mechanisms to form oligomers and monomers that can be digested and eliminated (20). The ester, ether, and amide functional groups found in the polymers used in this system come from both natural and synthetic sources. Poly esters and agro polymer (poly lactic acid, poly capro-lactone, poly anhydrides, poly-glycolic acid, etc.) are examples of polymers (21).

5.Matrix minerals:

Polysialates are a class of mineral polymers. Algins, a polysaccharide and hydrophilic seaweed that when hydrated forms a viscous gum, is one of the seaweed varieties whose polymers are utilised in this matrix system(22).

EVALUATION OF MATRIX TABLETS:

Thickness:

Twenty tablets were chosen at random from the representative sample, and each tablet's thickness was measured using a digital vernier calliper. Values for the average thickness and standard deviation were computed.

Friability test:

Ten pills were carefully weighted from each batch and placed in the Roche friabilator to test for friability. Tablets were examined while rotating on the apparatus for 4 minutes while it was run at 25 rpm. After 100 revolutions, the pills were then ingested, dusted, and reweighed. The percentage weight loss was used to calculate the friability.

Note: No tablet should adhere to the device's walls. If so, use talcum powder to dust the walls. Also, there shouldn't be any capping.

The following formula was used to compute the percentage of friability.

Where W1 is the initial weight of the 20 pills, % Friability is calculated as (W1 - W2) x 100/W1.

W2 stands for the 20 pills' final weight after testing.

Friability percentages under 0.8% are often acceptable.

Weight variation test:

investigating weight fluctuation Using an electronic balance, the individual weights (WI) of 20 tablets from each formulation were recorded. Calculated was their average weight (WA). This is how the percent weight variance was determined. weights of the average values for the standard deviation of the tablets were computed.

% weight variation = 100 divided by (WA-WI)

According to IP 1996, the total weight of the pills was 120 mg, hence a maximum of two tablets can have a 7.5% difference out of twenty. USP 2004 states that a 10% weight difference is permitted for no more than two tablets out of every twenty.

Drug content:

When the amount of the active ingredient in each of the 10 tested tablets falls between 90% and 110% of the standard level, the drug content of the matrix tablets is considered to be within acceptable limits. This was evaluated using internal standards.

Ten pills were measured, placed in a mortar, and ground into an extremely fine powder. A portion of the powder that was precisely weighed and accounted for approximately 100 mg of TM was added to a 100 mL volumetric flask with 70 mL of 0.1N HCl. For one hour, it was mechanically shaken. It was then diluted to 100 mL with 0.1N HCl after being filtered using a Whatman filter paper (No. 1) filter. 1 mL of the produced solution was collected and diluted to 50 mL using 0.1 HCL and absorbance was measured against blank at 295nm.

Invitro dissolution study:

Drug release was evaluated using a dissolution test in the following circumstances: n = 3, USP type II dissolution equipment (paddle method) at 100 rpm for the first two hours in 500 mL of 0.1N HCl, followed by three to twelve hours in phosphate buffer pH 6.8 at a temperature of 37 0.5 °C. At predetermined intervals, an aliquot (5 mL) was removed and replaced with an equal volume of freshly prepared dissolving medium that had been preheated to 37 °C 0.5 °C. The samples were taken out, filtered through Whatman filter paper No. 1, and their drug concentration was measured at 295 nm using a UV-visible spectrophotometer.

USP II dissolution testing equipment

100 rpm + 0.1 rpm

Stirrer: type paddle

Medium volume: 500 ml

Time intervals are 1, 2, 3, 4, 6, 8, 10 and 12 hours. The medium used is 0.1N HCl for the first 2 hours and phosphate

buffer 3 to 12 hours at pH 6.8

Temperature: 37 ± 0.5 0C

Kinetics of drug release:

The following equation was a straightforward relationship that addressed drug release from a polymeric system. First, 60% of the drug release data were fitted into the Korsmeyer-Peppas model to determine the mechanism of drug release.

$Mt / Kt^n = M$

Where K is the release rate constant taking into account the structural and geometric properties of the tablet, n is the release exponent, and Mt/M is the fraction of the medicine released at time t. Different release methods are characterised using the n value. Log cumulative% drug release was plotted against log time. The line's slope was n. The n value is used to describe various release processes for matrices with a cylindrical shape. Anomaly transport (Non-Fickian) relates to a phenomenon known as Case-II, which generally refers to the erosion of the polymeric chain and refer to combination of both diffusion and erosion controlled-drug release.

CONCLUSION:

Matrix type sustained release tablet are one of the safe, effective and convenient route dosage forms. The different type of matrix tablets of control release are prepared by using different polymers. There are different methods to prepare matrix tablets. Depending on the polymeric material there are different matrix systems. The successful preparation of matrix tablet depends upon the polymer used and method of preparation.

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