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A Review on "Oral Controlled Release Drug Delivery System"

Mr. Sagar Chaudhari[1], Prof. Sandip A Tadavi[2], Dr. Bhushan R Rane[3], Dr. Sunil P Pawar[4]

PG Scholar, P.S.G.V.P.Mandals College of Pharmacy ,Shahada , Maharashtra, India[1]
Professor, P.S.G.V.P. Mandals College of Pharmacy ,Shahada , Maharashtra, India[2,3]
Principal, P.S.G.V.P. Mandals College of Pharmacy ,Shahada , Maharashtra, India[4]

ABSTRACT- Oral drug delivery is the most favored and helpful choice as the oral course gives greatest dynamic surface territory among all drug delivery system for organization of different drugs. The engaging quality of these dose structures is because of attention to poisonous quality and insufficiency of drugs when managed by oral ordinary strategy in the type of tablets and cases. Typically traditional dose structure creates extensive variety of vacillation in drug focus in the circulation system and tissues with ensuing undesirable danger and poor effectiveness. The support of convergence of drug in plasma inside helpful record is extremely basic for compelling treatment.

These elements and elements, for example, redundant dosing and unusual assimilation lead to the idea of oral controlled release drug delivery systems. Controlled release drug delivery system takes a shot at various systems to control the release rate of drugs. Different components like osmotic weight, matrix system, reservoir system, changed thickness system and so forth have been used as detailing methodologies. The present article contains brief survey on different detailing approaches for controlled release drug delivery system.

KEYWORDS **-** Controlled release drug delivery system, matrix type system, reservoir system.

I. INTRODUCTION

Maintained release (S.R)/Controlled release (C.R) pharmaceutical items have slowly increased restorative acknowledgment and fame. Administrative endorsement for advertising and their pharmaceutics predominance and clinical advantages over prompt release pharmaceutical items have been progressively perceived. Altered release oral measurement frames have brought new rent of life into drugs that have lost business sector potential because of prerequisite of incessant dosing, dosage related poisonous impacts and gastrointestinal unsettling influences.

The term changed release drug item is used to portray items that modify the planning what's more, or the rate of release of the drug substance. A changed release dose structure is characterized "as one for which the drug-release Attributes of time course and/or area are proficient remedial or comfort targets not offered by ordinary measurements structures, for example, arrangements, treatments, or instantly dissolving measurements shapes as in a matter of seconds perceived". A few types of adjusted release drug items are perceived

Broadened release drug items: A measurement structure that permits no less than a twofold lessening in measurements recurrence when contrasted with that drug introduced as a quick release (customary) measurements structure. Case of expanded release measurements frames incorporate controlled-release, maintained release, and long-acting drug items.

Postponed release drug items: A measurements structure that releases a discrete part or bits of drug at once or now and again other than speedily after organization, in spite of the fact that one bit might be released quickly after

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Organization. Enteric-covered measurements frames are the most widely recognized postponed release items.

Focused on release drug items: A measurements structure that releases drug at or close to the expected physiologic site of activity. Focused on release dose structures may have either quick or amplified release qualities. The term controlled-release drug item was already used to depict different types of oral amplified release measurements frames, including managed release, supported activity, drawn out activity, long-activity, moderate release, what's more, customized drug delivery.

Traditional Drug Delivery System: Pharmaceutical items intended for oral delivery are for the most part ordinary drug delivery systems, which are intended for prompt release of drug for quick/prompt ingestion. As can be found in the chart , organization of the customary measurement structure by extra vascular course does not keep up the drug level in blood for a developed timeframe. The brief term of activity is expected to the powerlessness of routine measurements structure to control transient delivery.

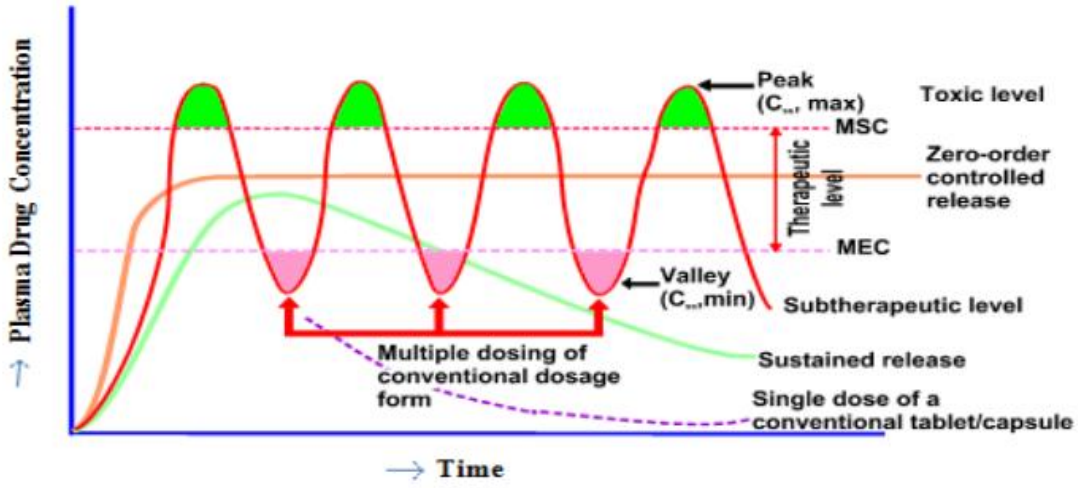

Fig. 1: A hypothetical plasma concentration-time profile from conventional multiple dosing and single doses of sustained and controlled delivery formulations. (MSC = maximum safe concentration, MEC = minimum effective concentration)

Classification of Oral Controlled Release System

A) Diffusion Controlled Systems

I. Reservoir Devices

II. Matrix Devices

B) Dissolution controlled system

I. Matrix Dissolution Controlled System

II. Encapsulation Dissolution Controlled system

C) Diffusion and Dissolution Controlled System.

A) Diffusion Controlled Systems

I. Reservoir Devices

A core of drug (the reservoir) surrounded by a polymeric membrane characterizes them. The nature of the membrane determines the rate of drug release. The characteristics of reservoir diffusion systems are

1. Zero order drug release is possible.

2. The drug release rate is dependent on the type of polymer.

3. High molecular weight compounds are difficult to deliver through the device. Coating and microencapsulation

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technique can be used to prepare sub devices.

II. Matrix Devices.

It consists of drug dispersed homogeneously in a matrix. The characteristics of the matrix diffusion system are

1. Zero order release cannot be obtained.
2. Easy to produce than reservoir devices.
3. High molecule weight compounds are delivered through the devices.

B) Dissolution controlled systems

I. Matrix Dissolution Controlled System

Aqueous dispersions, congealing; spherical agglomeration etc. can be used.

II. Encapsulation Dissolution Control

Particles, seeds or granules can be coated by technique such as microencapsulation.

C) Diffusion and Dissolution Controlled System.

In a bioerodible matrix, the drug is homogenously dispersed in a matrix and it is released either by swelling controlled mechanism or by hydrolysis or by enzymatic attack.

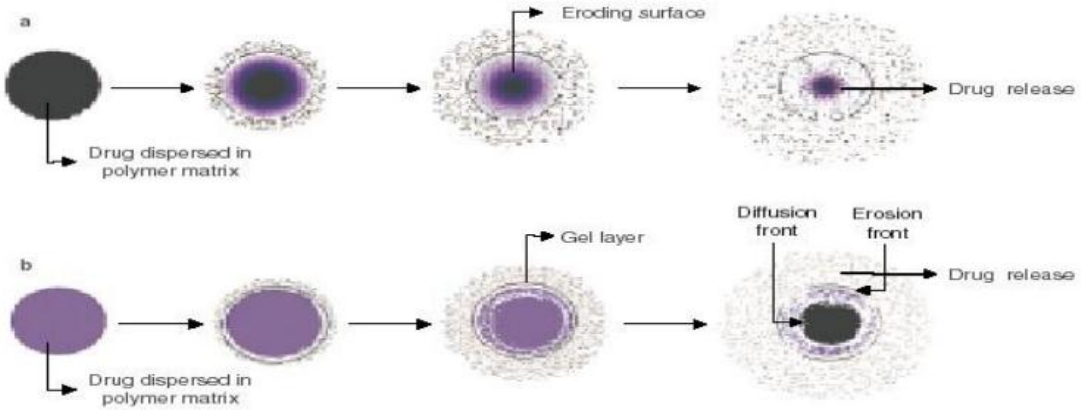

Fig. 2: Schematic drug release from matrix diffusion controlled-release drug delivery systems with the drug homogenously dispersed in: (a) an erodible polymer matrix; and (b) a hydrophilic, sellable polymer matrix

II. BIOLOGICAL FACTORS

1. Biological Half-Life

Helpful compounzds with half-life less than 8 hrs are phenomenal possibility for supported release arrangements. Drugs with short half-life (under 2 hrs) will require unnecessarily a lot of drug in each measurements unit to keep up controlled impacts. In this way driving the measurement structure itself to turn into too huge to be controlled. Mixes with moderately long half-lives, for the most part more noteworthy than 8 hrs are not utilized as a part of the managed release dose frames, subsequent to their impact is as of now maintained furthermore GI travel time is 8-12 hrs (Jantzen et al., 1996). So the drugs, which have long - half life and short half-life, are poor contender for managed release measurements frames. A few case of drug with half-existences of less than 2 hours are ampicillin, cephalexin, cloxacillin, furosemide, levodopa, penicillin G what's more, propylthiouracil. Case of those with half-existences of more noteworthy than 8 hours are dicumarol, diazepam, digitoxin, digoxin, guanethidine, phenytoin and warfarin.

2. Absorption

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The attributes of ingestion of a drug can enormously influence its appropriateness as a managed release item. Drugs which are consumed by particular transport process (bearer interceded) and drug ingestion at exceptional destinations of the gastrointestinal tract (Absorption Window) are poor possibility for maintained release items.

3. Metabolism

The metabolic transformation of a drug to another compound shape normally can be considered in the outline of a maintained release system for that drug. For whatever length of time that the area, rate and degree of digestion system are known and the rate constants for the procedures are not very extensive, effective maintained release items can be created.

There are two elements connected with the digestion system of a few drugs, however that present issues of their utilization in sustained release systems. One is the capacity of the drug to impel or restrain catalyst union, this may result in a fluctuating drug blood level with interminable dosing. The other is a fluctuating drug blood level because of intestinal (or other tissue) digestion system or through a hepatic first-pass effect.Examples of drugs that are liable to intestinal digestion system upon oral dosing are hydralazine, salicylamide, nitroglycerine, isoproterenol, chlorpromazine and levodopa. Case of drugs that experience broad initially pass hepatic digestion system are propoxyphene, nortriptyline, phenacetine, propranolol and lidocaine. Drugs that are essentially metabolized particularly in the district of the small digestive tract can indicate diminished bioavailability from slower discharging measurement frames. This is expected to immersion of intestinal divider protein systems.The drugs ought not have intestinal first pass impact and ought not affect (or) repress digestion system are great contender for managed release measurement frames. Different advances utilized for controlled release drug delivery systems were given in Table 2 (Chien et al., 1990).

III. DRUG RELEASE KINETICS -MODEL FITTING OF THE DISSOLUTION DATA

At whatever point another strong dose structure is created or delivered, it is important to guarantee that drug disintegration happens in an fitting way. The pharmaceutical industry and the enrollment powers do concentrate, these days, on drug disintegration examines.

Drug disintegration from strong measurements frames has been depicted by active models in which the broken down measure of drug (Q) is a component of the test time, tor Q=f (t). Some expository meanings of the Q (t) capacity are usually utilized, for example, zero request, first request, Hixson– Crowell, Higuchi, Korsmeyer-Peppas models. (Mulye and Turco, 1995; Colombo et al., 1999; Kim et al., 1997; Manthena et al., 2004; Desai et al., 1996; Higuchi et al., 1963).Different models communicating drug release energy were given in Table 4

Zero Order Kinetics

Dynamic condition for Zero request release is as takes after Q1 = Q0 +K0t Where Q1is the measure of drug broke down in time t, Q0is the underlying measure of drug in the arrangement (most times, Q0=0) and K0is the zero request release steady.

$$ft = K0\ t$$

Where ft = 1-(Wt/W0) and ft speaks to the division of drug broke down in time t and K0 the obvious disintegration rate steady or zero request release steady. Along these lines, a realistic of the drug-disintegrated part versus the reality of the situation will become obvious eventually be direct if the beforehand settled conditions were satisfied.

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Utilize: This connection can be utilized to portray the drug disintegration of a few types of changed release pharmaceutical dose frames, as in the instance of some transversal systems, also as matrix tablets with low dissolvable drugs, covered structures, osmotic systems, and so on. The pharmaceutical measurement shapes tailing this profile release the same measure of drug by unit of time and it is the perfect strategy for drug release to accomplish a pharmacological drawn out activity.

In the first place Order Kinetics

Motor condition for the principal request release is as takes after

$$\textbf{Log Qt = log Q0 + K1t/2.303}$$

Where Qt is the measure of drug released in time t, Q0 is the underlying measure of drug in the arrangement and K1 is the principal request release steady. Thusly a graphical representation of the decimal logarithm of the released measure of drug versus the reality of the situation will become obvious eventually direct.

The pharmaceutical measurements frames taking after this disintegration profile, for example, those containing water-solvent drugs in permeable lattices, release the drug in a way that is relative to the measure of drug remaining in its inside, in such way, that the measure of drug released by unit of time lessens.

$$\textbf{Higuchi Model ft = KH t1/2}$$

Where KH is the Higuchi disintegration consistent treated in some cases in an alternate way by distinctive creators and speculations. Higuchi portrays drug release as a dispersion procedure situated in the Fick's law, square root time subordinate. This connection can be utilized to portray the drug disintegration from a few types of altered release pharmaceutical measurement frames, as on account of a few transdermal system and matrix tablets with water-dissolvable drugs.

Hixson–Crowell model

Hixson and Crowell (1931) perceiving that the molecule standard territory is relative to the cubic foundation of its volume determined a condition that can be portrayed in the accompanying way

$$W0\ 1/3\text{-}Wt\ 1/3 = Kst$$

Where W0 is the underlying measure of drug in the pharmaceutical measurement structure, Wt is the

remaining measure of drug in the pharmaceutical dose structure at time tand Ks is a steady joining the surface–volume connection. This expression applies to pharmaceutical dose shape, for example, tablets, where the disintegration happens in planes that are parallel to the drug surface if the tablet measurements decrease relatively, in such a way that the underlying geometrical structure keeps steady constantly.

A realistic of the cubic foundation of the unreleased part of drug versus the reality of the situation will become obvious eventually direct if the balance conditions are not came to and if the geometrical state of the pharmaceutical dose structure lessens relatively over time. This model has been utilized to portray the release profile remembering the decreasing surface of the drug particles amid the disintegration.

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IV. MECHANISM OF DRUG RELEASE

To discover the drug release system due to swelling (upon hydration) alongside steady disintegration of the matrix, initial 60% drug release information can be fitted in Korsmeyer–Peppas model which is frequently used to portray the drug release conduct from polymeric systems at the point when the component is not surely understood or at the point when more than one type of release marvels is included (Korsmeyer et al., 1983).

$$\textbf{Log } (M_t/M_\infty) = \textbf{Log KKP + n Log t}$$

Where Mtis the measure of drug release at time t, M_∞ is the measure of drug release after limitless time, KKP is a release rate steady fusing auxiliary and geometrical attributes of the tablet, and n is the release type characteristic of the component of drug release.

Table 1: Examples of Oral Extended-Release Products

Type	Trade Name	Rationale
Erosion tablet	Constant-T	Theophylline
	enuate Dospan	Diethylpropion HCl dispersed in hydrophilic matrix
	Tedral SA	Combination product with a slow-erosion component (theophylline, ephedrine HCl) and an initial-release component theophylline, ephedrine HCl, phenobarbital)
Waxy matrix tablet	Kaon *Cl*	Slow release of potassium chloride to reduce GI irritation
Coated pellets in capsule	Ornade spansule	Combination of phenylpropanolamine HCl and chloropheniramine with initial- and extended-release component
Pellet in tablet	Theo-Dur	Theophylline
Leaching	Ferro-Gradumet (Abbott)	Ferrous sulfate in a porous plastic matrix that is excreted in the stool; slow release of iron decreases GI irritation
	Desoxyn gradumet tablet (Abbott)	Methamphetaminemethylacrylate,methylmethacrylatecopolymer, providone, magnesium stearate, the plastic matrix is porous
Coated ion-exchange	Tussionex	Cation ion-exchange resin complex of hydrocodone and phenyltoloxamine
Flotation–diffusion	Valrelease	Diazepam
Osmotic delivery	Acutrim	Phenylpropanolamine HCl (Oros delivery system)
	Procardia-XL	GITS—gastrointestinal therapeutic system with NaCl-driven (osmotic pressure) delivery system for nifedipine
Microencapsulation	Bayer timed-release	Aspirin
	Nitrospan	Microencapsulated nitroglycerin
	Micro-K Extencaps	Potassium chloride microencapsulated particles

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Table 2: Drug Release Kinetics

Kinetic Model	Relation	Systems Following the Model
First order	$\ln Q_t = \ln Q_o + K_t$ (release is proportional to amount of drug remaining)	Water-soluble drugs in porous matrix
Zero order	$f_t = K_o t$ (independent of drug concentration)	Transdermal systems Osmotic systems
Higuchi	$f_t = K_H t^{1/2}$ (proportional to square root of time)	Matrix formulations
Hixson-Crowell	$W_o^{1/3} - W_t^{1/3} = K_s t$	Erodible isometric matrices
f_t= fraction of dose release at time 't'. K_H, K_o, and K_s = release rate constants characteristic to respective models. Q_o= the drug amounts remaining to be released at zero hour. Q_t= the drug amounts remaining to be released at time't'. W_o= initial amount of drug present in the matrix. W_t= amount of drug released at time't'.		

V. CONCLUSION

In this paper, The controlled discharge drug conveyance framework plans to discharge the medication at the craved rate over stretched out timeframe to keep up the remedial level in blood. These days, the oral course of organization for controlled discharge drug conveyance framework has gotten more consideration because of its more adaptability, lessened dosing recurrence and better patient consistence. The configuration of oral controlled discharge drug conveyance framework relies on upon different elements like, physic-compound properties of medication, sort of conveyance framework, sickness being treated, and patient condition, and treatment length, nearness of nourishment, gastrointestinal motility and co-organization of different medications. From the above examination, we can reasoned that the controlled discharge drug conveyance framework is exceptionally accommodating in expanding the effectiveness of the measurements and in addition the patient consistence. In addition; the sensible expense of oral controlled discharge drug conveyance framework has lead simplicity of business sector infiltration as substitution of oral traditional medication conveyance framework.

REFERENCES

[1] Beckett AH, Stenlake JB, Practical Pharmaceutical Chemistry. 4th ed. Delhi: CBS Publisher and Distributors, 1997.

[2] P D Sethi, Quantitative Analysis of Drugs in Pharmaceutical Formulation, 3rded. Delhi: CBS Publisher and Distributors.

[3] P D Sethi, High Performance Liquid Chromatography, Delhi: CBS Publisher and Distributors.

[4] Higuchi T AndBrochman E, Hanseen H, Pharmaceutical Analysis, Delhi: CBS Publisher and Distributors, 2005.

[5] Mendham J, Denney RC, Barnes JD, Kthomas MJ, Vogel's text Book of Quantitative Chemical Analysis, 6thed. Pearson education Pvt Ltd, 2002.

[6] The Indian Pharmacopoeia, Government of India, Ministry of Health and Family Welfare, Published by India.

[7] Anderson NR et al., 1982. Quantitative evaluation of pharmaceutical effervescent systems I: design of testing apparatus.Pharm.Sci.71 (1): 3–6.

[8] Anderson NR et al.,1982. Quantitative evaluation of pharmaceutical effervescent systems II: stability monitoring by reactivity and porosity measurements' Pharm. Sci.71(1): 7– 13.

[9] Barra J, Somma R.,1996. Influence of the physicochemical variability of magnesium stearate on its lubricant properties: possible solutions. Drug DevInd Pharm..22(11): 1105– 1120.

[10] BillanyMR, Richards JH. ,1982.Batch variation of magnesiumstearate and its effect on the dissolution rate of salicylic acid from solid dosage forms. Drug DevInd Pharm.8: 497–511.

[11] BosCEet al.,1991. Lubricant sensitivity in relation to bulk density for granulations based on starch or llulose.Int JPharm.67:39–49.

[12] Bracconi P et al.,2003. Structural properties of magnesium stearate pseudo polymorphs: effect of temperature. Int J Pharm. 262(1–2):109– 124.

[13] BrittainHG.,1997. Raw materials.DrugDevInd Pharm.15(13): 2083–2103.

[14] Dansereau R., Peck GE.,1987 The effect of the variability in the physical and chemical properties of magnesium stearate on the properties of compressedtablets.DrugDevInd Pharm.13: 975–999.