EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 9
Issue: 5
132-140
Year: 2022

SUSTAINED RELEASE DRUG DELIVERY SYSTEM: A REVIEW

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Article Received on 08/03/2022 **Article Revised on 29/03/2022** **Article Accepted on 19/04/2022**

ABSTRACT

The terms Sustained-release, prolonged-release, modified release, extended-release, or depot formulations are accustomed to determine drug delivery systems that are designed to achieve or extend therapeutic effect by endlessly releasing medication over an extended amount of time when the administration of one dose. Presently pharmaceutical industries are specializing in the development of sustained-release formulations because of their inherent boons. Sustained continuously dose forms are designed to release a drug at a planned rate by maintaining a continuing drug level for a particular amount of your time with minimum aspect effects. The fundamental principle of a sustained-release drug delivery system optimizes the biopharmaceutical, pharmacokinetic, and, pharmacodynamics properties of a drug in such a way that its utility is maximized, side effects are reduced and cure of the sickness is achieved. There are many advantages of sustained-release (matrix) drug delivery over standard-dose forms like improved patient compliance because of less frequent drug administration, reduction of fluctuation in steady-state drug levels, most usage of the drug, inflated margin of safety of the potent drug, reduction in attention prices through improved medical care and shorter treatment amount. The fundamental goal of the sustained release is to give a promising way to decrease the aspect impact of the drug by preventing the fluctuation of the therapeutic concentration of the drug within the body and increasing patient compliance by reducing the frequency of dose.[1,2]

KEYWORDS: Sustained-release, Matrix tablet, Patient compliance.

INTRODUCTION

The goal in coming up with sustained or sustained delivery systems is to scale back the frequency of the dosing or to extend the effectiveness of the drug by localization at the site of action, reducing the dose needed, or providing uniform drug delivery. So, sustained-release (SR) does form could be a dose kind that releases one or a lot of medication endlessly during a planned pattern for a set amount, either systemically or to a specified organ. The oral route of administration for sustained release systems has received bigger attention due to a lot of flexibility in dose form style. The look of oral sustained release delivery systems are subjected to many reticulated variables of respectable importance like the kind of delivery system, the sickness being treated, the patient, the length of medical aid, and also the properties of the drug. A sustained-release system includes any drug delivery system that achieves slow release of drug over an extended amount. If the systems give some management, whether this can be of temporal or abstraction nature, or both, of drug release within the body, or in different words, the system is prospering at maintaining constant drug levels within the target tissue or cells, it's thought-about a controlled-release system.[3] Matrix tablets area unit thought-about to be the commercially possible sustained action dose forms that involve the smallest amount of process variables, utilize the standard facilities, and accommodate giant doses of the drug. There remains an interest in developing novel formulations that provide sustained drug release victimization pronto out there, cheap excipients by matrix-based formulations.

RATIONALE OF DEVELOPING SR DDS[3]

- To extend the duration of action of the drug.
- To reduce the frequency of dosing.
- To minimize the fluctuations in plasma level.
- Improved drug utilization.
- Less adverse effects.

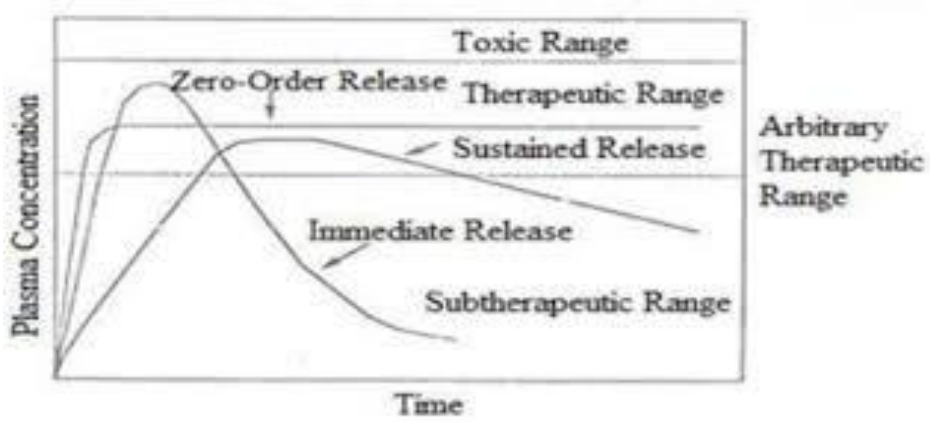


Fig. No.1: Plasma drug concentration profile for conventional release, a sustained release, and zero-order controlled release formulation.

PRINCIPLE OF SRDDS:

The conventional dosage forms release their active ingredients into an absorption pool immediately. This is illustrated in the following simple kinetic scheme. The absorption pool represents a solution of the drug at the site of absorption, Kr, Ka, and Ke - first order rate-constant for drug release, absorption, and overall elimination respectively.[4] Immediate drug release from a conventional dosage form implies that Kr>>>>Ka. For non-immediate release dosage forms, Kr<<<Ka i.e. the release of drug from the dosage form is the rate-limiting step. The drug release from the dosage form should follow zero-order kinetics, as shown by the following equation.

Kr° = Rate In = Rate Out = Ke.Cd.Vd----------1

Where,

Kr°: Zero-order rate constant for drug release-Amount/time

A: First-order rate constant for overall drug elimination-time

Cd: Desired drug level in the body – Amount/volume

Vd: Volume space in which the drug is distributed in the litter

ADVANTAGES OF SR DDS[4]

- Reduced dosing frequency
- Dose reduction
- Improved patient compliance
- A constant level of drug concentration in blood plasma
- Reduced toxicity due to overdose
- Reduces the fluctuation of peak-valley concentration
- Night time dosing can be avoided
- Economic
- The total amount of drug administered can be reduced, thus
- Maximizing availability with minimum dose
- Minimize or eliminate local side effects
- Minimize or eliminate systemic side effects
- Minimize drug accumulation with chronic dosing.

DISADVANTAGES OF SR DDS

- Probability of dose dumping
- Reduced potential for dose adjustment
- Cost of single unit higher than conventional dosage forms
- Increase potential for first-pass metabolism
- The requirement for additional patient education for proper medication
- Decreased systemic availability in comparison to immediate release conventional dosage Forms.
- Poor in vitro and in vivo correlations

DRUG SELECTION FOR ORAL SUSTAINED RELEASE DRUG DELIVERY SYSTEMS

The biopharmaceutical evaluation of a drug for potential use in a controlled release drug delivery system requires knowledge on the absorption mechanism of the drug from the G.I. tract, the general absorbability, the drug's molecular weight, pKa, solubility at different Ph, and apparent partition coefficient.

Pharmacokinetic parameters for drug selection:

Table No. 1: Parameters for drug selection for SR drug delivery system.

Parameter	Preferred value
Molecular weight /size	< 1000
Solubility	>0.1mg/ml for pH 1to pH 7.8
Apparent partition coefficient	High
Absorption mechanism	Diffusion
General absorbability	From all GI segments
Release	Should not be influenced by pH and enzymes

Table No. 2: Pharmacokinetic parameters for drug selection controlled drug delivery.

Parameter	Comment
Elimination half-life	Preferably between 0.5 and 8h
Total clearance	Should not be dose-dependent
Elimination rate constant	Required for design
Apparent volume of distribution Vd	The larger Vd and MEC, the larger will be the required dose size
Absolute bioavailability	Should be 75% or more
Intrinsic absorption rate	Must be greater than release rate
Therapeutic concentration CSS av toxic Concentration	The lower CSS av and smaller Vd the loss among of drug required part the values of MTC and MEC, safer the dosage form, Asio suitable for drugs with a very short half-life

CLASSIFICATION OF SR DDS[5,6]

1. Diffusion controlled release systems
2. Dissolution controlled release systems
3. Dissolution and diffusion controlled release systems
4. Ion exchange resin- drug complexes
5. pH-independent formulation
6. Osmotic pressure controlled systems

1. DIFFUSION CONTROLLED SYSTEM

Basically diffusion process shows the movement of drug molecules from a region of a higher concentration to one of lower concentration. This system is of two types.

a) Reservoir type: A core of drug surrounded by polymer membrane, which controls the release rate, characterizes reservoir devices

b) Matrix type: The matrix system is characterized by a homogenous dispersion of solid drugs in a polymer mixture.

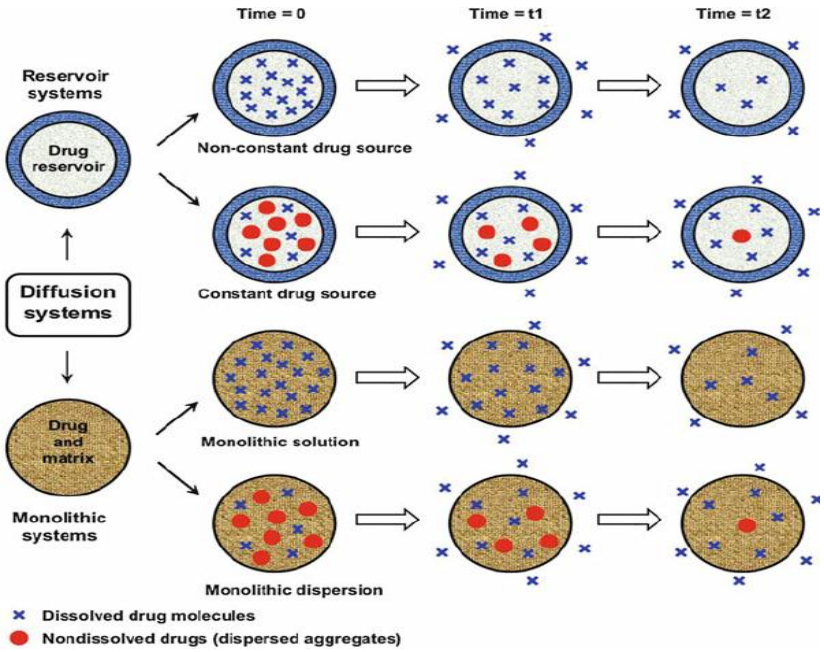


Fig.No.2: Schematic representation of Diffusion controlled release systems.

2. DISSOLUTION CONTROLLED SYSTEMS[7]

a) Reservoir type: The drug is coated with a given thickness coating, which is slowly dissolved in the contents of the gastrointestinal tract. By alternating layers of drug with the rate-controlling coats, as shown in figure no.3, a pulsed delivery can be achieved. If the outer layer is quickly releasing the bolus dose of the drug, initial levels of the drug in the body can be quickly established with pulsed intervals.

b) Matrix type: The more common type of dissolution controlled dosage form as shown in figure no. 3. It can be either a drug impregnated sphere or a drug impregnated tablet, which will be subjected to slow erosion.

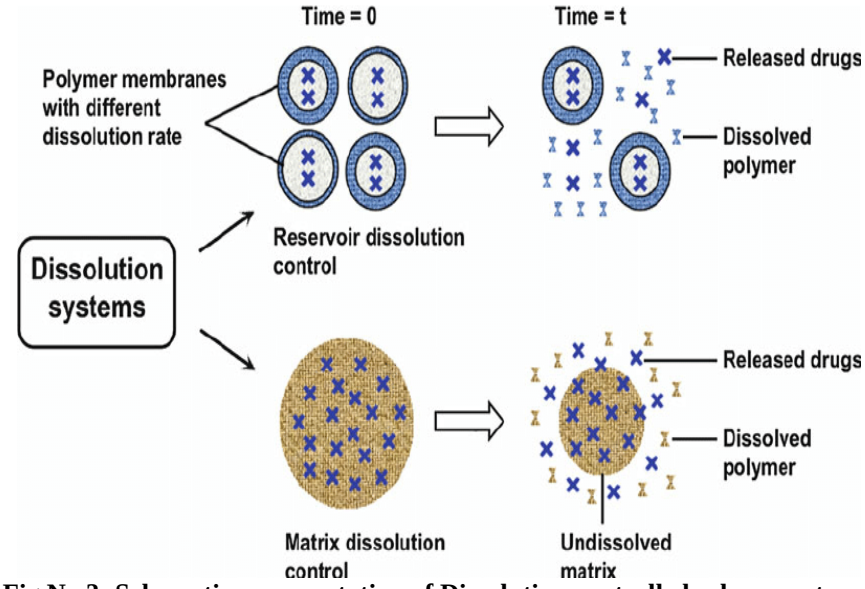


Fig.No.3: Schematic representation of Dissolution controlled release systems.

3. DISSOLUTION AND DIFFUSION CONTROLLED RELEASE SYSTEMS

In such systems, the drug core is encased in a partially soluble membrane. Pores are thus created due to the dissolution of parts of the membrane which permit entry of aqueous medium into the core and hence drug dissolution and allow diffusion of the dissolved drug out of the system.

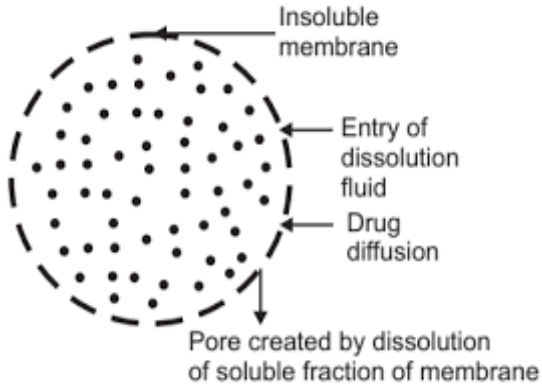


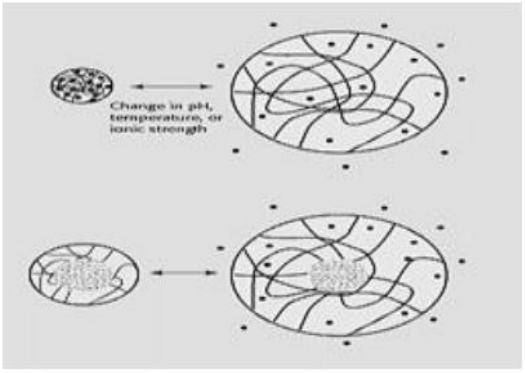
Fig.No.4. Schematic representation of Dissolution and Diffusion controlled release systems.

4. ION-EXCHANGE RESIN-DRUG COMPLEXES

It is based on the formulation of the drug resin complex formed when the ionic solution is kept in contact with ionic resins. The drug from this complex gets exchanged in the gastrointestinal tractand released with an excess of Na+ and Cl- present in the gastrointestinal tract. This system generally utilizes resin compounds of the insoluble cross-linked polymer. They contain salt-forming function groups in repeating positions on a polymer chain.

5. pH-INDEPENDENT FORMULATION

Most of the drugs are either a weak acid or weak base, the release from sustain release formulation is pH-dependent. However, a buffer such as a salt of citric acid, amino acid, tartaric acid can be added to the formulation, to help to maintain constant pH by retarding pH-independent drug release. A buffer sustain release formulation is prepared by mixing a basic or acidic drug with one or more buffering agents, granulating with appropriate excipients, and coating with a gastrointestinal fluid-permeable film-forming polymer. When gastrointestinal fluid permeates through the membrane, the buffering agent adjusts the fluid inside to suitable constant pH thereby rendering a constant rate of drug release.



6. OSMOTIC PRESSURE CONTROLLED SYSTEMS

A semi-permeable membrane is placed around the tablet, particle, or drug solution that allows transport of water into a tablet with eventual pumping of drug solution out of the tablet through the small delivery aperture in the tablet core. Two types of osmotic pressure controlled systems are

I. Type 1 contains an osmotic core with drug
II. Type 2 contains the drug in a flexible bag with an osmotic core surrounding By optimizing formulation and processing factor, it is possible to develop an osmotic system to deliver the drug of diverse nature

at a pre-programmed rate.

NOVEL TRENDS IN SRDDS[8,9,10]

For orally administered dosage forms, sustained drug action is achieved by affecting the rate at which the drug is released from the dosage form and or by slowing the transit time of dosage form through the gastrointestinal tract. Zahirul Khan has classified the sustained release dosage form based on its structural and physical appearance as, single unit dosage form, multiple-unit dosage form, and mucoadhesive delivery systems.

Single Unit Dosage Forms

This refers to a diffusion-controlled system where the therapeutic agent is evenly distributed (Dispersed /dissolved) throughout the solid matrix. This system can be classified as follows.

Complex reservoir system or coated tablets or multi-layered system

The core material which typically, the drug alone or blended with hydrophobic or hydrophilic Inert material and it is compressed into tablets.

Hydrophobic/Swellable tablets

Optimum alkaloids such as morphine salts are homogenized with their salt and fatty acid or an ethylene-vinyl acetate copolymer (hydrophobic filler) and then compressed into tablets.

Semisolid matrix systems

In this system, the drug is incorporated in an oily "semisolid" hydrophobic carrier, and finally, mass is typically filled into a gelatin capsule to prepare dosage form.

Ion exchange resins

A drug–resin complex is formed by prolonged exposure to the drug to the resin. The drug from these complexes gets exchanged in the gastrointestinal tract and later they are released with an excess of Na+ and Cl- present in the gastrointestinal tract.

Osmotic pump

The system is composed of a core tablet surrounded by a semipermeable membrane coating having a 0.4mm diameter hole produced by laser beam 16. The tablet, particle, or drug solution that allows transport of water into a tablet with eventual pumping of drug solution out of the tablet through the small delivery aperture in tablet coating.30. E.g. Glucotrol XL (glipizide) tablets (Pfizer), Covera – HS ® (verapamil HCl) tabs. (Searle).

Multiple Unit Dosage Forms

It represents a mixture of the dosage form, the source of which may either be homogenous or heterogeneous. The various available forms are Multi tablet systems Small spheroids compressed tablets 3 to 4 mm in diameter may be prepared to have varying drug release characteristics. They may be placed in gelatin capsule shells to provide the desired pattern of drug release Coated Beads, granules& Microsphere In these systems, the drug is distributed onto beads, pellets, granules, or other particulate systems. Using conventional pan coating or air suspension coating, a solution of the drug substance is placed on small inert nonpareil seeds or beads made of sugar and starch or on microcrystalline cellulose spheres. Pellets are prepared by coating inert drug pellets with film-forming polymers. The drug release depends upon the coating composition of polymers and the number of coatings. Microencapsulation is a process by which solids, liquids, or even gases may be enclosed in microscopic particles by the formation of thin coatings of wall material around the substance. Mucoadhesive Delivery System. It utilizes the principle of adhesion for optimum delivery of the drug from the device. The Mucoadhesive system is suitable to increase the contact time of the drug with absorbing membrane and localization of delivery of drug at targeted sites.

FACTORS AFFECTING THE ORAL SUSTAINED RELEASE DOSAGE FORM DESIGN

A) Pharmacokinetics and pharmacodynamics factor

Drugs with a biological half-life of 2-8 hours are considered a suitable candidate for sustainrelease dosage form since this can reduce dosing frequency. However this is limited in that drugs with very short biological half-lives may require excessive large amounts of the drug in eachdosage unit to maintain sustained effects, forcing the dosage form itself to become limitingly large.

1. Absorption

The rate of absorption of a sustained formulating depends upon the release rate constant of the drug from the dosage form, and for the drugs that are absorbed by active transport, the absorption is limited to the intestine.

2. Distribution

The distribution of drugs into tissues can be an important factor in the overall drug elimination kinetics. Since it not only lowers the concentration of circulating drug but it also can be rate-limiting in its equilibrium with blood and extravascular tissue, consequently apparent volume of distribution assumes different values depending n the time course of drug disposition. Thus for the design of sustain release products, one must have information on the disposition of the drug.

3. Metabolism

The metabolic conversion to a drug is to be considered before converting into another form. Since as long as the location, rate, and extent of metabolism are known a successful sustain release product can be developed.

B) Drug properties relevant to sustained release formulation

1. Dose size

A dose size of 500-1000mg is considered maximal for a conventional dosage form. This also holds for sustain release dosage forms. Since dose size consideration

serves to be a parameter for the safety involved in the administration of large amounts with a narrowtherapeutic range.

2. Ionization, pKa, and aqueous solubility

Most drugs are weak acids or bases and for a drug to get absorbed, it must dissolve in the aqueous phase surrounding the site of administration and then partition into the absorbing membrane.

3. Partition coefficient

The bioavailability of a drug is largely influenced by the partition coefficient, as the biological membrane is lipophilic in nature transport of the drug across the membrane largely depends upon the partition coefficient of the drug. Drugs having a low partition coefficient are considered as poor candidates for the sustain release formulation as they will be localized in the aqueous phase e.g.: Barbituric acid and vice versa.

4. Drug stability

When drugs are orally administered, they come across acid-base hydrolysis and enzymatic degradation. In this case, if the drug is unstable in the stomach, a drug release system that provides medication over an extended period is preferred, whereas, in contrast, the drug unstable in the intestine will face the problem of less bioavailability.

Evaluation for SRDDS[11]

Evaluation of these dosage form done by two ways

I. Evaluation of granules
II. Evaluation of tablets

Evaluation of granules involve following test

Angle of repose

The angle of repose was determined using the funnel method. A funnel was secured on a stand at a fixed height` above a graph paper placed on a horizontal surface. The sample was poured until the apex of the conical pile touched the tip of funnel. The radius of the conical pile was measured and the angle of repose calculated as follows: $V = Tan^{-} 1 (h/r)$

Bulk density

The bulk density was calculated using equation:
$\rho b = MV$
Where
ρb = Bulk density,
M = Mass of the granules in gm
V = Final untapped volume of granules in ml.

True density

The true density was measured using equation;
$\rho t = M/VP$
Where,
ρ t = true density
M =Mass of granules in gm.,
VP = Final tapped volume of granules in ml.

Loss on drying (LOD)

The moisture content of the lubricated granules was analysed by using IR moisture analyser. 5.0 gm. or more quantity of granules was heated at 105^0c until the change in weight was no more observed by the instrument. The % loss in weight was recorded.

Compressibility index

This was measured for the property of a powder to be compressed; as such they are measured for relative importance of inter-particulate interactions. Compressibility index was determined by following equation.
Compressibility index = (Dt – Db) × 100
Where, Dt = Tapped density,
Db = Bulk density

Hausner's ratio

It was calculated by following equation.
Hausner ratio = Dt / Do
Where, Dt = Tapped density,
Do = Bulk density
Evaluation of SR tablets involve following test

Weight variation

To study weight variation, 20 tablets of each formulation were weighed using an electronic balance (citizen India) and test was performed according to official method.
Friability:
In this twenty tablets were weight and placed in the Roche friabilator and apparatus was rotated at 25rpm for 4min. After revolution the tablet were dusted and weight.
% friability = Wo - W/Wo × 100
Where, Wo = Initial weight of twenty tablet
W = weight of 20 tablet after 100 revolution.

Hardness

Tablet hardness was measured by using Monsanto hardness tester from each batch six tablets were measured for the hardness and an average of six values was noted along with and an average of six values was noted along with standard deviation.

Thickness

Twenty tablets from the sample were randomly taken and individual tablet thickness was measured using digital Vernier calliper. Average thickness and standard deviation values were calculated.

***In-vitro* drug release rate**

Formulated tablet were subjected to invitro dissolution study using USP type I / II apparatus (paddle) at 100 rpm with temperature of water bath maintain at 37 ± 0.5^{o}c. Dissolution was carried in 900 ml simulated gastric fluid for 2 hrs and for further 8 hrs in simulated intestinal fluid. The release of different drugs at different time interval was measured at particular wavelength by U.V-visible spectrophotometer.

Methods used in tablet manufacturing

A. Wet granulation
B. Dry granulation
C. Direct compression

Granulation:

Generally the powders material cannot be punching directly into tablet form, because (a) the material should not have bonding a property to each other into compaction and (b) insufficient flow character from the hopper into die cavity. For this reason and this nature of material we can go for granulation methods.

The reason for granulation.

- Become the pharmaceutical ingredient are free flowing
- Increase the denseness of ingredient
- We can formulate uniform granular size that does not existing apart
- Produce better compression characteristic of drug
- Controlling the rate of drug release from the dosage form
- Reduce dust in granulation technique
- The appearance of tablet can be achieved

A. Wet granulation

Size reduction of active ingredient and inactive ingredient, proper mixing of crushed powders, preparation of binder solution by using standard binder, pouring the binding agent with powder mixture to form coherent mass, the wet mass is screening using 6 to 12 sieve mesh, drying the shifted granules, sieving prepared granules with lubricant and glidant, mixing screened granules with lubricant and glidant, finally compressed into tablet form.

Advantages

- Powder material is converted into granular form by adding binding solution, the use of binder it's coating the each powder material to get a granules which having better cohesiveness and compressibility for manufacturing of tablet.
- If an active component it has been high label claim and also improper flow characteristic can be prepared by wet granulation technique to acquire excellent flow of granules and its granular material having cohesiveness for punching.
- Uniform distribution of active ingredient as well as uniform active content quantity of prepared dosage form.
- In many pharmaceutical ingredient can cause the dust and airborne pollute it could be handling without producing this problem by granulation method.
- In these methods prevent the agglomeration of ingredient in a homogeneous powder mixture under processing, shifting and handling.
- Controlled release dosage form can be developed by the manufacturing scientist using better binding agent and polymer or solvent.
- This procedure entrapment of air in the material can be reduced.

Disadvantages

- It needs a number of equipments in the production area.
- There is a chances of pollute than the direct compression
- In these method timing period is increase because moistening the material and drying process.
- This method not suitable for sticky ingredient and hygroscopic substance.

Advantages

- In this method the material are highly heats sensitive and destroyed in moisture condition so we can formulate by dry granulation method.
- It needs less space for placing the equipment and processing step than other methods.
- The ingredient cost is smaller in extent.

Disadvantages

- For this method, either the active material or inactive material should have binding properties and cohesive nature.
- The ingredient must be in the nature of either crystalline or amorphous form.

B. Direct compression

Size reduction of active component and inactive component, mixing of milled ingredients, tablet compression.

Advantages

- The exposing of active component to moisture and thermal can be prevented.
- These methods the cost of preparation can be minimized and reduce the labor cost.
- Tablet manufactured by this process very easy to disintegrating molecule from the dosage form.
- The equipment like granulators and dryers and solvent are not needed in manufacturing of tablets by this method.

Disadvantages

- The uniformity of color is difficult to achieve in manufacturing of tablets.
- In this process cost of materials is a great vertical extent.
- In this method produce dust and air pollute during manufacturing process.
- Content uniformity is not maintained, because agglomeration and separation of drug molecule it will occur in transferring from hopper into die cavity.

Classification Polymer Type[12]

Origin - Natural, Semi synthetic, Synthetic
Thermal Response - Thermoplastic, Thermosetting
Mode of formation - Addition, Condensation
Line structure - Linear, Branched, Cross-linked
Application and Physical Properties - Rubber, Plastic, Fibers

Crystallinity
Non crystalline(amorphous), Semi-crystalline, Crystalline
Polarity - Polar, Non polar
Chain - Hetro, Homo-chain

Classification on Basis of Nature

Natural polymer

The polymers, which occur in nature are called natural polymer. Natural polymers are also known as biopolymers. Examples of such polymers are natural rubber, natural silk, cellulose, starch, proteins, etc.

Semi synthetic polymer

Semi synthetic polymers are the chemically modified natural polymers such as hydrogenated, natural rubber, cellulosic, cellulose nitrate, methyl cellulose, etc.

Synthetic polymer

The polymers which are synthesized in the laboratory are known as synthetic polymer. Synthetic polymers are also known as manmade polymers. Examples of such polymers are polyvinyl alcohol, polyethylene, polystyrene, polysulfone.

Gums and mucilage in sustained drug delivery system

Among various dosage drug delivery system, Matrix system is the specific type of release system, which prolongs and controls the release of drug that is dissolved or dispersed. Making drug-embedded matrix tablets through the direct compression of a blend of drug, retardant material and additives is one of the dosage forms-Disperse system and simplest formulation approaches. polymeric materials in a matrix system is a common method of modulating drug release.Gums and mucilages have been examined as polymer for versatile sustained release formulations. The use of natural excipients for pharmaceutical formulations, polymers and their semi-synthetic derivative in drug delivery continues to be an area of active research. Drug-release retarding polymers are the key performers Academic Press, London. in matrix systems. Various polymers have been A study on investigated as drug retarding agents, each presenting a binding properties of guggal different approach to the matrix system. Based on the features of the retarding polymer, matrix systems are usually classified into three main groups: Hyprophilic hydrophobic and plastic.

Gum Damar

Whitish to yellowish natural gum obtained from plant Shorea wiesneri (family Dipterocarpaceae). Gum damar (GD) contains about 40% alpha-resin (resin that dissolves in alcohol), 22% 13 beta resin, 23%dammarol acid and 2.5% water. It has been used for water-resistant coating and in pharmaceutical and dental industries for its strong binding 90 properties . In India, Sal damar has been widely utilized in 91 the indigenous system of medicine .Natural gum copal and gum damar as novel sustained release matrix forming materials in tablet formulation was evaluated. Matrix tablets were prepared by wet granulation technique using isopropyl alcohol as a granulating agent. Diclofenac sodium was used as a model drug. Effect of gum concentration (10, 20 and 30% w/w with respect to total tablet weight) on in vitro drug release profile was examined. Matrix tablets with 30% w/w gum copal and gum damar showed sustained drug delivery beyond 10 h. Drug release from gum copal matrix tablets followed zero order kinetics while gum damar (10 and 20% w/w) was found suitable to formulate the insoluble plastic matrix that releases the drug by diffusion. It was concluded that both gums possess substantial matrix forming property that could be used for sustained drug delivery.

Tamarind Gum

From the endosperm of the seed of the tamarind tree tamarind xyloglucan is obtained, Tamarind usindica, a member of the evergreen family. Tamarind Gum, also known as Tamarind Kernel Powder (TKP) is extracted from the seeds. Tamarind gum is a polysaccharide composed of glucosyl: xylosyl: galactosyl in the ratio of 3:2:1.Xyloglucan is a major structural polysaccharide in the primary cell walls of higher plants. Tamarind xyloglucan has a (1 4)-D-glucan backbone that is partially substituted at the O-6 position of its glucopyranosyl residues with "-D-xylopyranose". It is insoluble in organic solvents and disperses in hot water to form a highly viscous gel such as a mucilaginous solution with a broad pH tolerance and adhesivety. The properties of tamarind gum include non carcinogenicity, mucoadhesivity, biocompatibility, high drug holding capacity and high thermal stability.

Bhara Gum

From the plant of Terminalia bellerica roxb gum Bhara is obtained it is a yellowish natural gum belonging to family Combretaceae. Bahera gum, extracted from the bark of Terminalia bellerica. Main chemical constitutents are tannins which mainly include ß- sitosterol, gallic acid, ellagic acid,ethyl gallate, galloylglucose and chebulaginic acid It has been mainly used as a demulcent and purgative. It is also used as an emulgent in cosmetic industries. Wide applications of bhara gum indicate their hydrophilic nature, and compatibility with the physiologic environment. A new sustained release microencapsulated drug delivery system employing bhara gum has been proposed, were formulated by ionic gelation technique using famotidine as the model drug. The effect of different drug: bhara gum ratio on in vitro drug release profile was examined and compared with guar gum. Remaining all parameters was constant. Microcapsules employing bhara gum exhibited slow release of famotidine over 10 hr. Fickian release was observed from most of the formulations with bhara gum. It was concluded that this gum possesses substantial release controlling properties that could be used for sustained drug delivery.

Table No. 3: Some important materials are used for preparing sustained-release tablets.

DRUG	POLYMER
Tramadol Hydrochloride	Carrageenan gum, Karaya gum,
Aceclofenac	Carbopol 971P, Carbopol
Ambroxol Hydrochloride	HPMC
Metoprolol succinate	HPMC K100M, Xanthan gum

MASR$_X$ Sustained-Release Technology[2]

Marx Technology The objective is to assess factors affecting drug release from guar-gum-based once-daily matrix sustained-release formulations (MASRx). The tablets were designed to hydrate completely into the tablet core. In the process, the tablet core expanded and released the drug in a sustained release manner.

COSR$_X$ Technology

Formulations based on constant sustained-release matrix (COSRx) technology can also be developed using guar gum as a major rate-controlling polymeric material. Depending on the solubility of the drug, low- or high-viscosity guar gum can be used. The formulation involves a guar-gum-base tablet and a combination of water-soluble and water-insoluble polymeric tablet coats. When the tablet is placed in a dissolution medium, there is slow diffusion of water through the polymeric wall leading to swelling and gelations of the guar gum/drug core. As the hydration progress, the tablet continues to swell until the wall breaks, forming a sandwich-like structure. The release of the drug proceeds primarily out of the sides of the tablet as it passes through the intestinal tract. The tablets provide a nearly zero-order drug release.

CONCLUSION

There are many reasons for the attractiveness of those dosage forms: provides raised bioavailability of drug product, reduction within the frequency of administration to prolong period of effective blood levels reduce the fluctuation of peak-trough concentration and aspect effects, and presumably improves the particular distribution of the drug. If one were to develop a perfect drug delivery system, 2 prerequisites would be required: first single dose for the length of treatment whether for days or weeks as with infection, polygenic disorder, or high blood pressure. Second, it ought to deliver the active entity onto the positioning of action minimizing the side effects.

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