Class: MPhil (Pharmaceutics)

Semester: First (Spring 2020)

Course Name: Advanced Pharmaceutics-I

Course Code: PHM-701

Chapter No. 4.2

OSMOTICALLY CONTROLLED DRUG DELIVERY SYSTEM

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Osmotically controlled drug delivery system

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Introduction

A flow of a solvent from a compartment with low concentration of a solute to a compartment with high concentration. The two compartments are separated with a semi-permeable membrane which only allows the passage of a solvent but not solute.

The drug release from these system are independent of physiological factors of GIT and can be use for systemic and targeted drug delivery system. This system is induced for drug delivery at pre-programmed rate by reducing the frequency of administration, possible side effects and toxicity.

Steps of a release process

- Transport of solvent into drug delivery system by osmosis.
- Dissolution of a drug with in the unit

- Convective transport of a saturated drug solution by pumping of the solution through a single orifice/pores in a semi-permeable membrane.

Osmotic drug delivery system can be classified into following categories on the basis of state of use and osmotic drug delivery devices design:

- Implantable osmotic pump
- Oral osmotic pump
- Specific types

Implantable osmotic pump

It consist of osmotic engine and a piston disposed within the compartment. The osmotic engine is made that allows the piston to move within the compartment and expel the active ingredient present within the compartment, when the pump is implanted in an aqueous environment.

2. A)Osmotic pumps for humans (Oral)	Description
• Elementary osmotic pump (Alza Corp., USA)	Single layer tablet for delivery of drugs having moderate water solubility. Can be utilized for zero-order delivery as well as pulsed release.
• Push–pull osmotic pump (Alza Corp.)	Bilayer tablet, used to deliver drugs having low to high water solubility. Products such as Ditropan XL (oxybutynin chloride), Procardia XL (nifedipine), and Glucotrol XL (glipizide) are based on this technology. Number of modifications available such as delayed push–pull system, multi-layer push–pull system, and push–stick system.

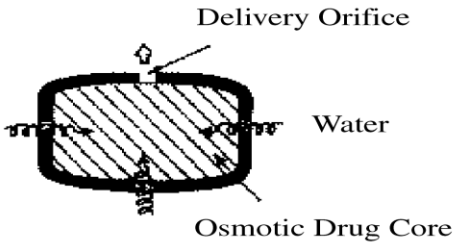
• L-OROS (Alza Corp.)	Designed to deliver lipophilic liquid formulations and is suitable for delivery of insoluble drugs.
• OROS-CT (Alza Corp.)	For targeted delivery to colon and can be used for local or systemic therapy.
• Portab System (Andrx Pharmaceuticals, USA)	Tablet core consists of soluble agent, which expands and create microporous channels for drug release.
• SCOT (single composition osmotic tablet, Andrx Pharmaceuticals)	Utilizes various osmotic modulating agents and polymer coatings to provide zero-order release.
• ENSOTROL drug delivery system (Shire Labs. Inc., USA)	Utilizes various solubilizing and wicking agents for delivery of poorly water soluble drugs.
• Zero-Os tablet technology (ADD Drug Delivery Technologies AG, Switzerland)	Specifically for delivery of lipophilic compounds. Consists of gel forming agents in the core that forms gel after coming in contact with water and drug is released as a fine dispersion.

B) Osmotic pumps for humans (Implantable)	**Description**

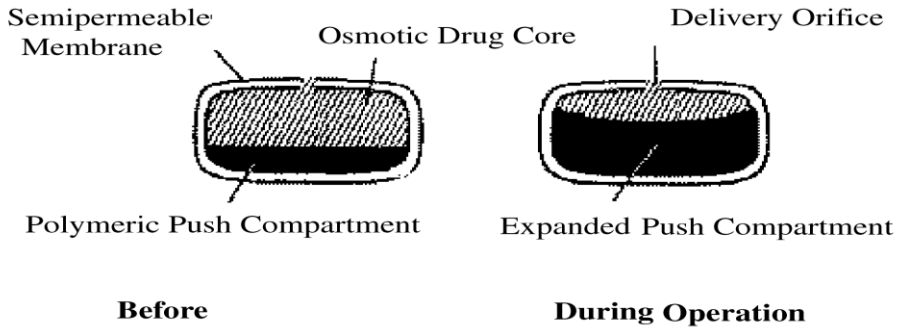
• DUROS (Durect Corp.)	Miniature (4345 mm), implantable osmotic pumps for long-term, parenteral, zero-order delivery of potent therapeutic agents. Deliver drugs at a precisely controlled and constant rate within therapeutic range for long periods. Viadur (leuprolide acetate), a successful product in the market, delivers leuprolide continuously at a nominal rate of 125 mg/day over 1 year for palliative treatment of prostate cancer. DUROS sufentanil (3 months continuous delivery for treatment of chronic pain) and DUROS hydromorphone (for continuous delivery to the spine) are in various developmental phases.

3. Osmotic pumps for veterinary use	**Description**
• VITS (veterinary implantable therapeutic system, Alza Corp.)	Designed to deliver drugs at a controlled rate in animals for a period of 1 day to 1 year and can be implanted subcutaneously or intraperitoneally in any ruminant, non ruminant, companion, or production animals. Available in various sizes (2–10 mm in diameter) and can be designed to give delivery rates from mg/day to mg/ day. Drug is kept isolated from body fluids and thus, can be used to deliver water-labile compounds, e.g. proteins and peptides.

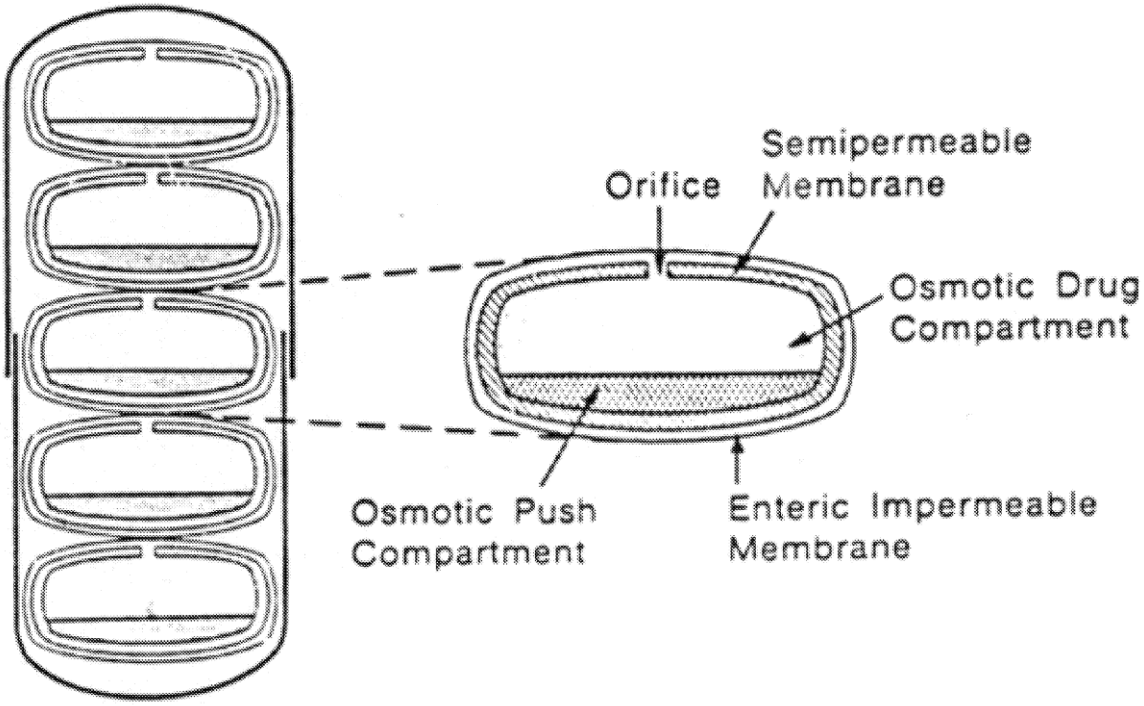
• RUTS (ruminal system, therapeutic Alza Corp.)	For controlled delivery of drugs up to 1 year in the rumen of cattle and sheep. Up to 10 g of drug can be administered. Generally 2–3 cm in diameter and up to 10 cm in length but larger dimensions are possible depending upon application. Can be designed for zero-order delivery of up to g/day for durations ranging from 1 day to 1 year. Ivomec SR (ivermectin) and Dura SE (sodium selenite) available commercially.

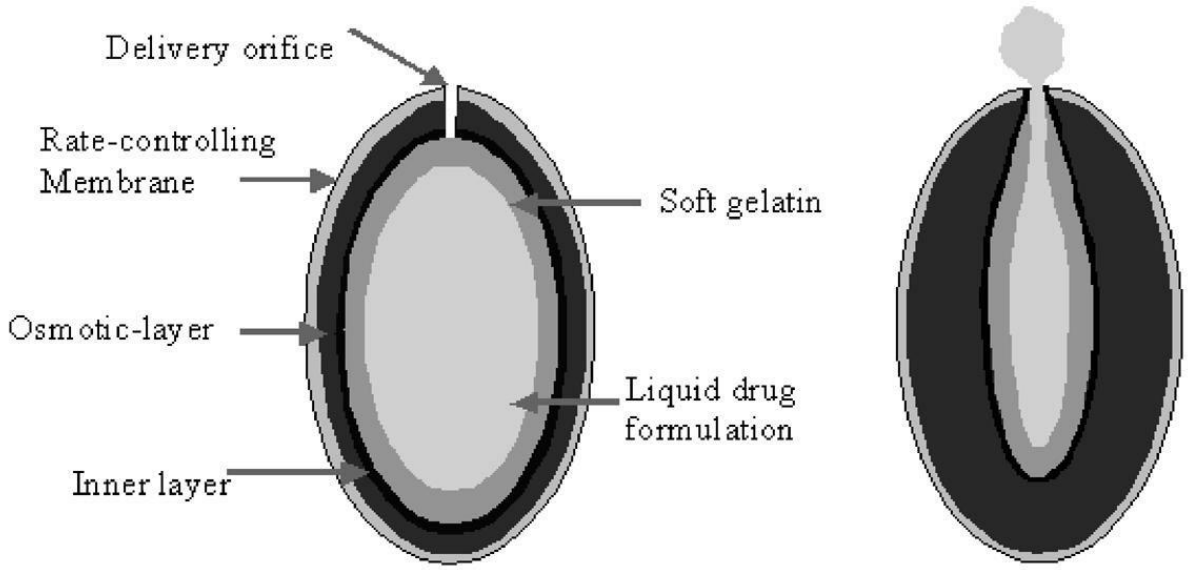

Delivery Orifice
Water
Osmotic Drug Core

(a)

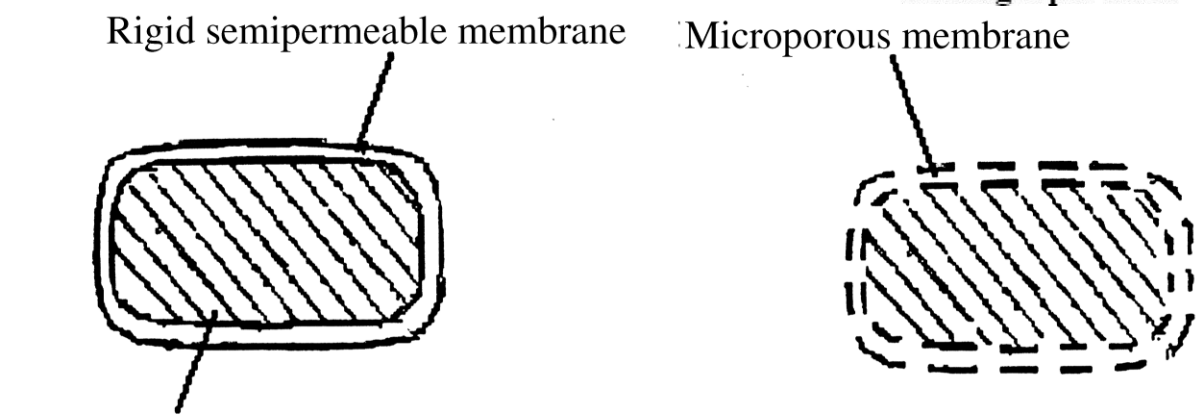

Semipermeable Membrane
Osmotic Drug Core
Delivery Orifice
Polymeric Push Compartment
Expanded Push Compartment
Before
During Operation

(b)

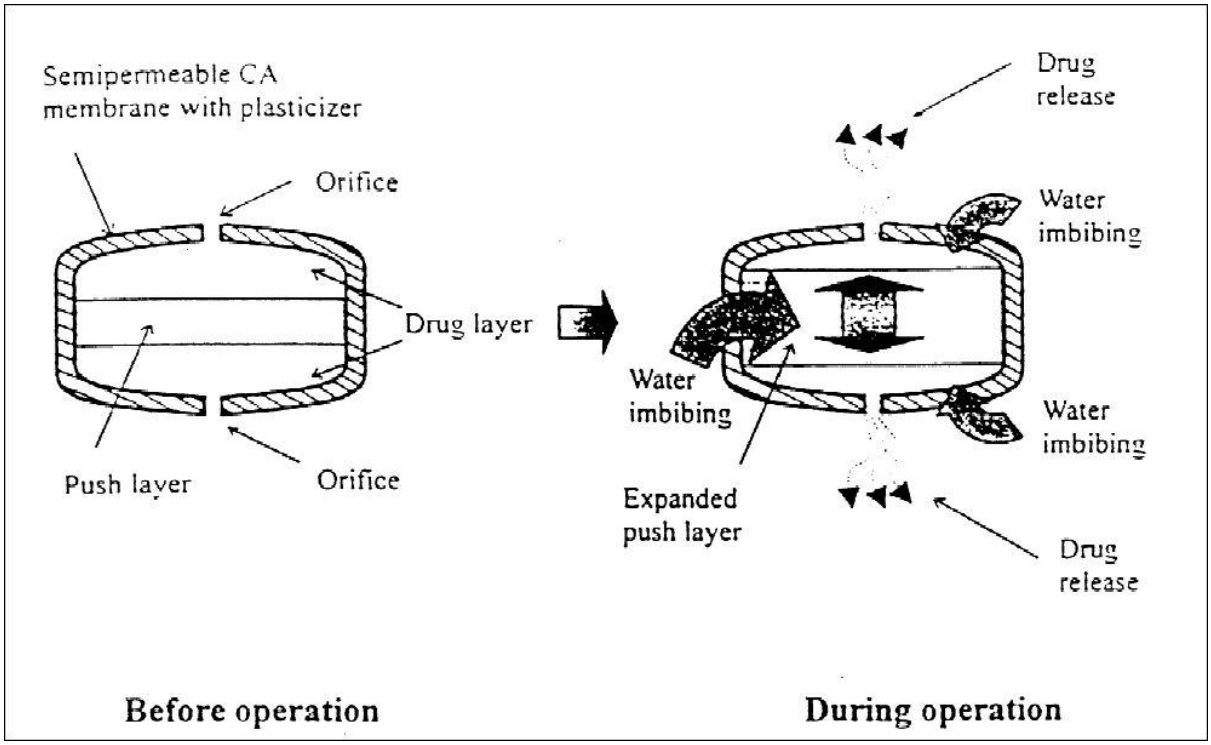

Orifice
Semipermeable Membrane
Osmotic Drug Compartment
Osmotic Push Compartment
Enteric Impermeable Membrane

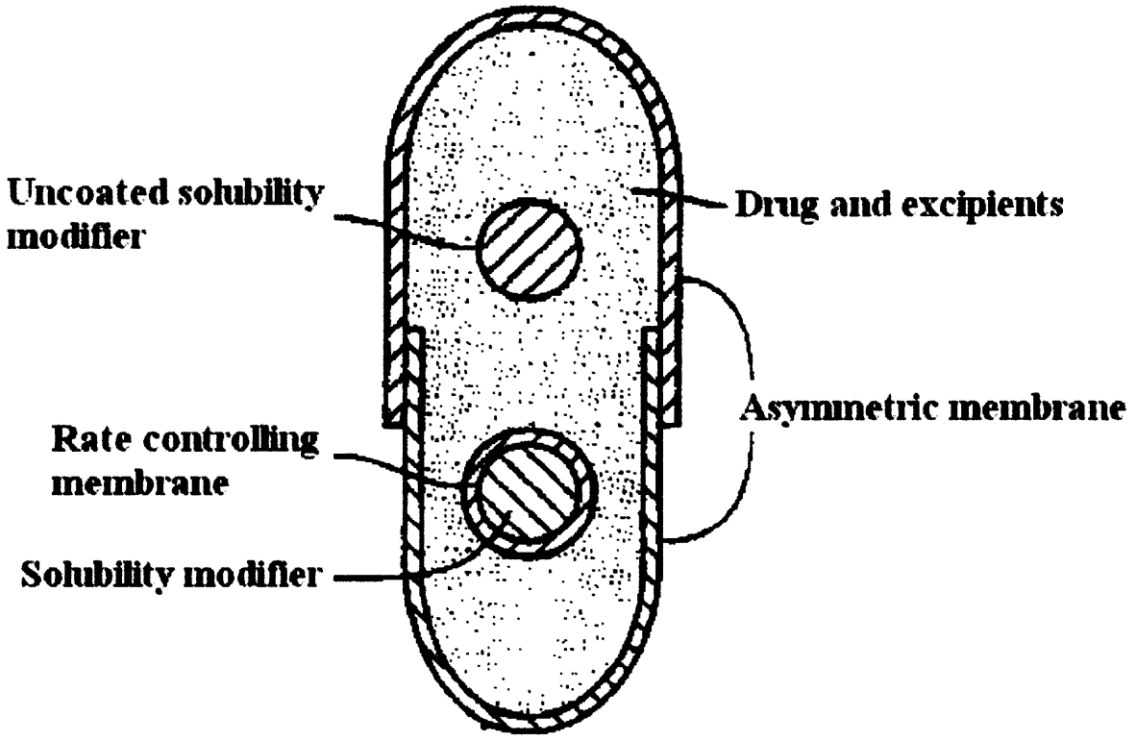


Before Operation **During Operation**



Before operation **During operation**





Controlled porosity osmotic pump (CPOP)

An osmotic tablet in which a membrane contains water soluble leachable pore forming agents. The coating of semi-permeable membrane is done by a suitable coating material usually water soluble pore forming additives. The membrane is permeable to water but impermeable to solute. When CPOP is exposed to water, the membrane become porous forming a

sponge like structure that allows the drug leach through pores when water enters through a semi-permeable membrane and dissolves a drug.

Delivery orifices can be created by laser drilling. The rate of flow of water into a device can be expressed as:

Where $\boldsymbol{dv/dt}$ is rate of flow of water to the device, $\boldsymbol{k}$ and $\boldsymbol{A}$ are membrane permeability and surface area of membrane respectively, $\boldsymbol{d\pi}$ and $\boldsymbol{dp}$ are osmotic pressure difference and hydrostatic pressure difference between inside and outside of the membrane respectively.

Advantages of controlled porosity osmotic pump

- The release of drugs from CPOP tablets follows zero order kinetics after an initial lag.
- The delivery of drug may be delayed or pulsatile.
- The release of a drug is independent of physiological features of body including gastric pH, drug and hydrodynamic condition.
- The drug delivery provides high degree of in vitro in vivo correlation.
- Drug release is higher than conventional DDS.
- Drug release is less affected by presence of food in GIT.
- Drug delivery rate from CPOP is predictable and programmable.
- There is no need of laser drilling because the holes are formed in situ.
- Scale up production is very easy.
- The stomach irritation problems are reduced because the drug is delivered from entire surface rather than a single delivery orifice.

Disadvantages of controlled porosity osmotic pump

- Preparation method is very costly.
- Retrieval therapy is not controllable in case of unexpected adverse effects.
- There is a chance of dose dumping if coating process is not well controlled.
- There is a chance of development drug tolerance.

Components of osmotic system

Basic components of osmotic system are:

- Drugs
- Osmotic components/ osmogents
- Semi-permeable membrane
- Coating solvents
- Emulsifying agents
- Flux regulating agents
- Wicking agents
- Plasticizers
- Pore forming agents
- Barrier layer formers

A. Drugs

Drugs that are water soluble in nature and are highly potent can be designed in this system only I.e. Nifedipine, Glipizide.

B. Osmotic components/osmogents

Osmotic agents maintains a concentration gradient across the membrane which is essential for designing osmotic formulations.

a) Water soluble salts of inorganic acids osmogents

Magnesium chloride or sulphate, sodium chloride, sodium sulphate, potassium chloride, sodium bicarbonate, sodium or potassium hydrogen sulphate etc.

b) Organic polymeric osmogents

Sodium carboxyl methyl cellulose, hydroxyl propyl methyl cellulose,Hydroxyl methyl cellulose, methyl cellulose, polyethylene oxide, polyvinyl pyrollidine, polyacrylamides, carbopols etc.

c) Carbohydrates

Arabinose, ribose, xylose, glucose, fructose, galactose, mannose, sucrose, maltose, lactose, raffinose etc.

d) Water soluble amino acids

Glycine, leucine, alanine, methionine etc.

e) Water soluble salts of organic acid osmogents

Sodium and potassium acetate, magnesium succinate, sodium benzoate, sodium citrate, sodium ascorbate etc.

C. **Semi-permeable membrane**

A selectively permeable membrane that permits the passage of solvents only but not solutes.

Ideal properties of semi-permeable membrane

- Material must have sufficient wet strength and wet modulus.
- Membrane must have rigid dimensional integrity during operational time of device.
- Membrane must have sufficient water permeability to retain water flux rate in desired range
- Reflection coefficient and osmotic agent leakage should approach limiting value of unity.

D. **Coating solvents**

These solvents are suitable for making polymeric solutions used to manufacture wall of osmotic devices including inert organic and inorganic solvents.

They might be use as a ***single solvent*** or ***mixture of solvents***; methylene chloride, acetone, methanol, ethanol, isopropyl alcohol, butyl alcohol, ethyl acetate, cyclohexane, carbon tetrachloride, water etc use as a single solvent. Whereas acetone-methanol (80:20), acetone-ethanol (80:20), acetone-water (90:10), methylene chloride-methanol (79:21), methylene chloride-methanol-water (75:22:3) etc are use in combinations

E. **Emulsifying agents**

They are added to produce integral composition which is useful to wall forming material of a device that regulate the surface energy of material, improve their blending into the composite and maintain their integrity in environment of use during the drug release period.

Examples are polyoxyethylenated glyceryl recinoleate, polyoxyethylenated castor oil having ethylene oxide, glyceryl laureates, glycerol (sorbitan oleate, stearate or laurate) etc.

F. **Flux regulating agents**

Flux regulating or flux enhancing or flux decreasing agents are used in wall forming material to regulate the fluid permeability of flux through wall. They may be hydrophilic substances or hydrophobic substances.

The ***hydrophilic substances*** increases the flux I.e polyethylene glycols, polyhydric alcohols, polyalkylene glycols etc.

Whereas the ***hydrophobic substances*** decreases the flux I.e Phthalates substituted with alkyl or alkoxy (diethyl phthalate or dimethoxyethyl phthalate).

G. **Wicking agents**

These agents draws water into a porous network of delivery device which have a capability of ***Physisorption***. Physisorption is a form of absorption in which a solvent molecules can loosely adhere to surfaces of wicking agent through vanderwaal's interactions between the surface of agents and absorbed molecule. These agents functions to carry water inside core creating channels and network of increased surface area.

Common examples are colloidal silicon dioxide, kaolin, titanium dioxide, alumina, niacinamide, polyvinyl pyrolidone, bentonite, sodium lauryl sulphate etc.

H. **Plasticizers**

They are used to lower the temperature in phase transition of wall and also increases workability, flexibility and permeability of fluids.

Examples are phthalates (dibenzyl, dihexyl, butyl, octyl), triace tin, epoxidizedtallate, triisoctyltrimellitate, alkyladipates, citrates, acetates, propionates, glycolates, myristates, benzoates, halogenated phenyls etc.

I. Pore forming agents

These agents form micro-porous structure in membrane due to their leaching during the operation of a system usually used for poorly water soluble drugs. They may be inorganic and organic in nature.

Examples are Alkaline metal salts such as sodium chloride, sodium bromide, potassium chloride, potassium sulphate, potassium phosphate etc. Alkaline earth metals such as calcium chloride, calcium nitrate etc. Carbohydrates such as sucrose, glucose, fructose, mannose, lactose, sorbitol, mannitol, diols, polyols etc.

J. **Barrier layer formers**

Barrier layer formers restrict water entry into a certain parts of the delivery system and separate drug layer from the osmotic layer.

Examples are high density polyethylene, wax, rubber etc.

Key parameters that influence the design of osmotic controlled drug delivery systems

Following parameters affect the design of OCDDS:

- Orifice size
- Solubility
- Osmotic pressure
- Semi-permeable membrane

Orifice size

The cross sectional area of orifice must be smaller than a maximum size Smax in order to achieve an optimal zero-order delivery profile and to minimize drug delivery by diffusion through orifice. The minimum cross sectional area can be estimated from the equation:

$$S_{\min} = 5\left[\left(\frac{L}{P_{\max}}\right)\mu\left(\frac{dV}{dt}\right)\right]^{\frac{1}{2}}$$

Where

dV/dt = volume flux through orifice

L = length of orifice (usually same as the thickness of membrane)

μ = viscosity of drug solution flowing through orifice

Pmax = maximum tolerated hydrostatic pressure difference across the membrane before the occurrence of deformation of housing

Solubility

The release rate depend upon the solubility of solute inside a DDS. Therefore, drugs should have sufficient solubility to be delivered by osmotic delivery.

Osmotic pressure

Osmotic pressure π directly affects the release rate, in order to achieve a zero order release rate, it is essential to keep π constant by maintaining a saturated solute solution.

Semi-permeable membrane

Membrane is permeable to water and not to ions, the release rate is essentially independent of pH of environment. Moreover, process of drug dissolution takes place inside a delivery system, completely separated from the environment.

GASTRORETENTIVE DRUG DELIVERY SYSTEMS

1. **. Introduction**

- Oral drug administration has been the predominant route for drug delivery.
- Gastric residence time is time which a drug resides in stomach.
- Depends upon fluid and food intake.
- GRDDS are designed to delay gastric emptying (1)

2. Need of Gastric retention

2.1. Gastro retention is done for

- Drugs that absorb from stomach (Levodopa, Furosemide).
- Acting locally in stomach (Antacids, Antiulcer and Enzymes).
- Antibiotic therapy.
- Poorly soluble at alkaline pH.(Diazepam, Salbutamol)
- Narrow window of absorption (2)

2.2. Gastric retention is unsuitable for

- Drugs having limited acid solubility. (Phenytoin)

- Instable in gastric conditions. (Erythromycin)
- Extensive first pass metabolism. (3)

3. Advantages

- Improved drug absorption, because of increased GRT and more time spent by the dosage form at its absorption site.
- Controlled delivery of drugs.
- Minimizing mucosal irritation by releasing drugs slowly at a controlled rate.
- Treatment of gastrointestinal disorders such as gastro-oesophageal reflux, providing local action.
- Ease of administration and better patient compliance.

4. Limitations

- **Retention in the stomach is not desirable for drugs that cause** gastric lesions (e.g. Non- steroidal anti-inflammatory drugs NSAIDs).
- Drugs that are degraded in acidic environment of stomach (e.g. Insulin).
- Drugs that undergo a significant first-pass metabolism (e.g. Nifedipine).
- Drugs that have very limited acid solubility (e.g. Phenytoin).

5. Factors controlling gastric retention of dosage forms

5.1. Density of dosage forms

5.2. Shape and size of the dosage form

5.3. Food intake and its nature

5.4. Effect of gender, posture and age

5.1. Density of dosage forms

- The density of a dosage form also affects the gastric emptying rate and determines the location of the system in the stomach.
- Dosage forms having a density lower than the gastric contents can float to the surface, while high density systems sink to bottom of the stomach.

5.2 Shape and size of the dosage form

- Shape and size of the dosage forms are important in designing indigestible single unit solid dosage forms.
- In most cases, the larger the dosage form the greater will be the gastric retention time (GRT) due to the larger size of the dosage form would not allow this to quickly pass through the pyloric antrum into the intestine.

5.3. Food intake and its nature

- Food intake, viscosity and volume of food, caloric value and frequency of feeding have a profound effect on the gastric retention of dosage forms.
- The presence or absence of food in the gastrointestinal tract (GIT) influences the gastric retention time (GRT) of the dosage form.
- Usually the presence of food in the gastrointestinal tract (GIT) improves the gastric retention time (GRT) of the dosage form and thus, the drugs absorption increases by allowing its stay at the absorption site for a longer period.

5.4. Effect of gender, posture and age

- Generally females have slower gastric emptying rates than male. The effect of posture does not have any significant difference in the mean gastric retention time (GRT) for individuals in upright, ambulatory and supine state. In case of elderly persons, gastric emptying is slowed down.

6. Approaches to achieve gastric retention

6.1. High density (sinking) system or non- floating drug delivery system

- This approach involves formulation of dosage forms with the density that must exceed density of normal stomach content (~ 1.004 gm/cm3).
- These formulations are prepared by coating drug on a heavy core or mixed with inert materials such as iron powder, barium sulphate, zinc oxide and titanium oxide etc.

6.2. Floating drug delivery systems

- These are low-density systems.

- Have ability to float over gastric contents.
- The drug is must have sufficient structure to form a cohesive gel barrier.
- It must maintain an overall specific gravity lower than that of gastric contents.
- Eased from the system at desired rate.

6.2.1. Floating Techniques

6.2.1.A. Effervescent

I. Gas generating systems

II. Volatile liquid containing systems

6.2.1.B. Non-Effervescent

I. Colloidal gel barrier systems

II. Alginate beads

III. Hollow Microspheres

IV. Microporous Compartment System

6.2.1.A. Effervescent systems

i. **<u>Gas generating systems</u>**

- Effervescence is there.
- Utilizes effervescent reactions between carbonate/bicarbonate salts and citric/tartaric acid.
- CO_2 is released in presence of H_2O.
- When tablet is put in beaker it will sink
- With production of gas it rises up and floats.

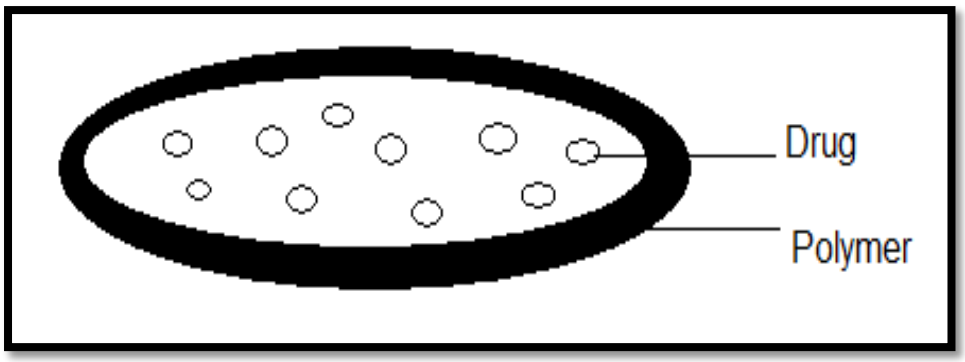
ii. **Volatile liquid containing systems**

- Incorporates an inflatable chamber, which contains a liquid e.g. ether, cyclopentane, that gasifies at body temperature to cause the inflation of the chamber in the stomach.
- There systems are very less used as the gas generating systems are more safe.

6.2.1.B. Non-effervescent systems

i. Colloidal gel barrier systems

- Such systems contains drug with gel forming hydrocolloids meant to remain buoyant on stomach contents.
- These systems incorporate a high level of one or more gel forming highly Swellable cellulose type hydrocolloids. e.g. HEC, HPMC.
- On coming in contact with gastric fluids forms a viscous core.
- Incorporates H_2O and entraps air.



ii. Microporous membrane systems

- Based on the encapsulation of drug reservoir inside a Microporous compartment.
- The peripheral walls of the drug reservoir compartment are completely sealed to prevent any direct contact of the gastric mucosal surface with the undissolved drug.
- Gastric fluid enters through the apertures, dissolves the drug, and carries the dissolve drug for absorption.

iii. Alginate beads

- Spherical beads of approximately 2.5 mm in diameter can be prepared by dropping a sodium alginate solution in to aqueous solutions of calcium chloride, causing precipitation of calcium alginate.
- The beads are then separated snap and frozen in liquid nitrogen, and freeze dried at -40°C for 24 hours, leading to the formation of porous system.
- Maintain a floating force of over 12 hours.

iii. Hollow microspheres

- Micro balloons / hollow microspheres loaded with drugs are prepared by simple solvent evaporation method.
- Commonly used polymers to develop these systems are polycarbonate, cellulose acetate, calcium alginate, Eudragit S, agar and pectin etc.
- These systems have capacity to float on acidic dissolution media containing surfactant for about 12 hours invitro.

6.3. Mucoadhesive systems

- Involves the use of bio adhesive polymers, which can adhere to the epithelial surface in the stomach.
- Dosage form can stick to mucosal surface by following mechanisms:
  - The wetting theory
  - The diffusion theory
  - The absorption theory
  - The electron theory

6. 4. Swellable systems

- A dosage form in the stomach will withstand gastric transit if it bigger than pyloric sphincter, but should be small enough to be swallowed.
- These systems swells many times its original size.
- Cross-linking should be optimum highly cross-linked do not swell.
- Chitosan, HPMC, sodium starch glycolate, carbopol are used.
- Diclofenac, Ciprofloxacin, Furosemide are reported with these systems.

7. Evaluation of GRDDS

7.1. Floating drug delivery systems

- **Floating time**

Determined by using the USP dissolution apparatus containing 900 ml of 0.1 N HCL maintained at 37o C. The time for which the dosage form floats is termed as the floating time.

- **Muco – Adhesion system**

  - Measurement of either tensile or shear strength is the most commonly used invitro method to measure bio adhesion strength.

7.3. Swelling systems

Weight gain and water uptake

- Done by immersing the dosage in simulated gastric fluid at 37oC and determining these factors at regular intervals.
- Dimensional changes can be measured in terms of increase in the tablet diameter or thickness with time.

8. Commercial Gastro retentive Formulation

Name	Type and drug	Remarks
MadoparHBSâ (PropalHBS)	Floating capsule, Levodopa and benserazide	Floating CR capsules
Valrelease	Floating capsule, Diazepam	Floating Capsules
Topalkan	Floating Antacid, aluminum and magnesium mixture	Effervescent floating liquid alginate preparation
Conviron	Ferrous sulphate	Colloidal gel forming FDDS
Cifran OD	Ciprofloxacin (1 gm)	Gas generating floating form

10. Future Potential for Gastric Retentive Delivery Systems

- ❑ Gastric retentive dosage forms based on flotation have been commercialized in Europe; gastric retentive tablets based on size and food have been and are being developed.

- ❑ Technologies based on retention in the fasted state still are being investigated for various indications, but their complexity, and reproducibility, as well as evaluation of their efficacy and safety in vivo, await identification of a therapy justifying their increased cost and risk of development and manufacture.

Biodegradable Polymers AS A DRUG Delivery Systems

INTRODUCTION

- The term "polymer" derives from the ancient Greek word polus, meaning "many, much" and meros, meaning "parts", and refers to a molecule whose structure is composed of multiple repeating units.
- A polymer is a large molecule (macromolecules) composed of many repeated subunits, known as monomers. monomers can be linked together in various ways to give linear, branched and cross linked polymers etc.

CHARACTERISTICS OF AN IDEAL POLYMER

- Should be versatile and possess a wide range of mechanical, physical, chemical properties.
- Should be non-toxic and have good mechanical strength and should be easily administered.
- Should be inexpensive
- Should be easy to fabricate.
- Should be inert to host tissue and compatible with environment.

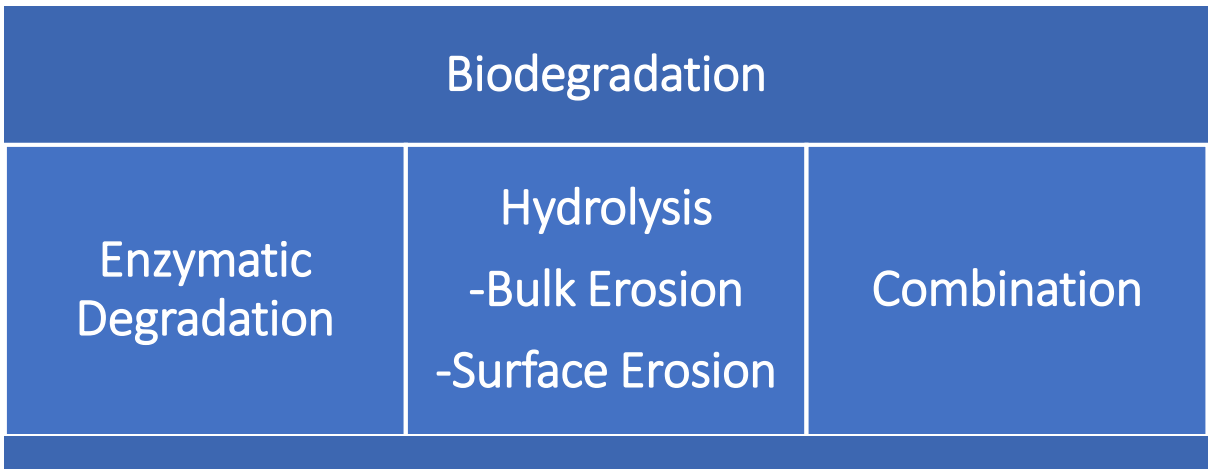
BIODEGRADABLE POLYMERS

- Biodegradable polymers are defined as polymers comprised of monomers linked to one another through functional groups and have unstable links in the backbone.
- They are broken down into biologically acceptable molecules that are metabolized and removed from the body via normal metabolic pathways.

Rationale for the Use of Biodegradable Systems

- Conventional drug therapy typically involves periodic dosing of a therapeutic agent that has been formulated in a manner to ensure its stability, activity, and bioavailability.
- The concept of drug delivery therefore was, introduced to overcome this limitation of conventional therapy. Many oral sustained release products have been formulated successfully and are available on the market.

Mechanism of Biodegradable Polymers



<u>Enzymatic Degradation</u>

Mechanism I

Cleavage of Crosslinks

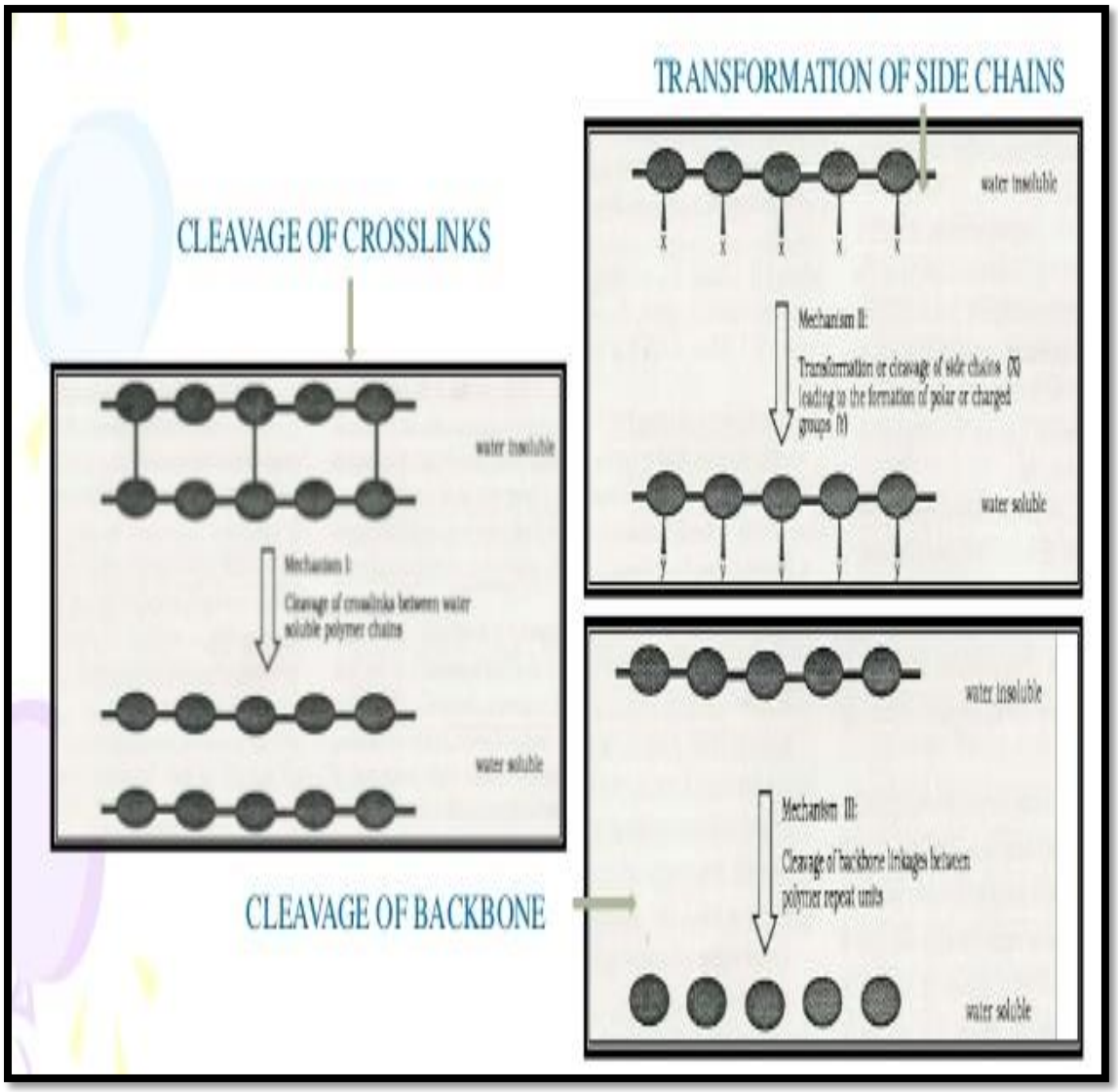
Mechanism II

Transformation of Side

Chains

Mechanism III

Cleavage of Backbone



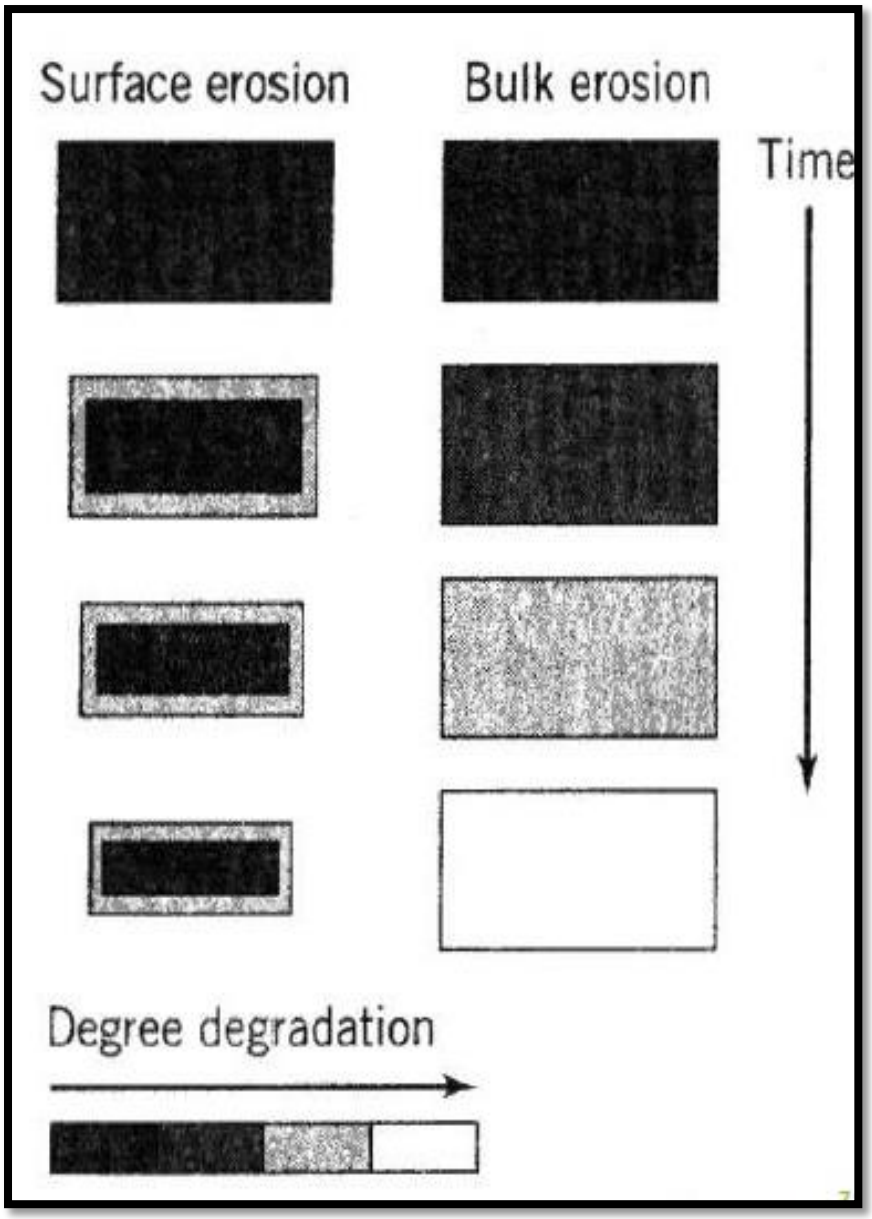
Hydrolysis

Bulk erosion

- Degradation takes place throughout the whole of the sample.
- Ingress of water is faster than the rate of degradation.
- *E.g. Polylactic Acid (PLA)*

Surface erosion

- Sample is eroded from the surface.
- Mass loss is faster than the ingress of water into the bulk.
- *E.g. Polyanhydrides*



Classification of biodegradable polymers based on the source

Synthetic biodegradable polymers*ers)*

• These are prepared by ring opening and polymerization of cyclic ester.

a) *poly (glycolic acid)*
b) *poly (lactic acid)*
c) *poly (caprolactone**)***

- Polyglycolide or Polyglycolic acid (PGA) is a biodegradable, thermoplastic polymer and the simplest linear, aliphatic polyester.

- Used to deliver drugs in the form of microspheres, implants etc.,

- Examples of drugs delivered include steroid hormones, antibiotics, anticancer agents etc.

1) Aliphatic poly(esters)

b) POLYLACTIC ACID

- Polylactic acid or polylactide (PLA) is a thermoplastic aliphatic polyester derived from renewable resources, such as corn starch.
- It can biodegrade under certain conditions, such as the presence of oxygen, and is difficult to recycle.

- PLA is used in the preparation of sutures or orthopedic devices.

Polycaprolactone (PCL) is a biodegradable polyester.

- It remains active as long as a year for drug deliver
- Drug delivery applications of PCL includes:
  - Cyclosporine in the form of nanoparticles
  - Ciprofloxacin in the form of dental implants

2) Poly anhydrides

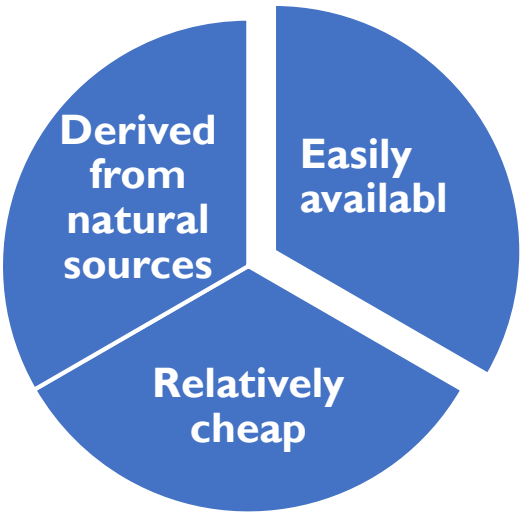
- Highly reactive and hydrolytically unstable.
- Degrade by surface degradation without the need for catalysts.
- Suitable for short term drug delivery.
- Used for vaccination and localized tumor therapy.

3) Polyphosphazenes

- Its hydrolytic stability/instability is determined by change in side group attached to macromolecular backbone.
- Used in the construction of soft tissue prosthesis, tissue like coatings, as material for blood vessel prosthesis.
- Used for immobilization of antigen or enzyme.
- Use for drug delivery under investigation

Natural biodegradable polymers

- Natural polymers are an attractive class of biodegradable polymers as they are:



1) Collagen

- Collagen is the most widely found protein in mammals and is the major provider of strength to tissue.
- The number of biomedical applications in which collagen have been utilized is too high; it not only has been explored for use in various types of surgery, cosmetics, and drug delivery.
- It is used as sutures ,Dressings, etc.

Disadvantages

- Poor dimensional stability. Variability in drug release kinetics.
- Poor mechanical strength.

Applications

- Majorly used in ocular drug delivery system.

2) Albumin

- It is a major plasma protein component.
- It accounts for more than 55% of total protein in human plasma.
- It is used to design particulate drug delivery systems.

Applications

- Albumin micro-spheres are used to deliver drugs like Insulin, Sulphadiazene, 5-fluorouracil, Prednisolone etc.

- It is mainly used in chemotherapy, to achieve high local drug concentration for relatively longer time.

3) Dextran

- Dextran is a complex branched polysaccharide made of many glucose molecules joined into chains of varying lengths.
- Used for colonic delivery of drug in the form of gels.
- Replacement of Blood loss.
- Thrombosis Prophylaxis.
- Improvement of Rheology.

4) Gelatin

- Gelatin is a mixture of peptides and proteins produced by partial hydrolysis of collagen, extracted from the boiled bones, connective tissues, organs and some intestines of animals.
- Gelatin is an irreversible hydrolyzed form of collagen, Physicochemical properties depends on the source of collagen, extraction method and thermal degradation.

Applications

- Employed as coating material.
- Gelatin micro pellets are used for oral controlled delivery of drugs.

ADVANTAGES OF BIODEGRADABLE POLYMERS

- Localized delivery of drug
- Sustained delivery of drug
- Stabilization of drug
- Decrease in dosing frequency
- Reduce side effects
- Improved patient compliance
- Controllable degradation rate

APPLICATIONS OF BIODEGRADABLE POLYMERS

- Polymer system for gene therapy.

- Biodegradable polymer for ocular, tissue engineering, vascular, orthopedic, skin adhesive & surgical glues.
- Bio degradable drug system for therapeutic agents such as anti tumor, antipsychotic agent, anti-inflammatory agent.
- Polymeric materials are used in and on soil to improve aeration, and promote plant growth and health.
- Many biomaterials, especially heart valve replacements and blood vessels, are made of polymers like Dacron, Teflon and polyurethane.

Future Potential

- Numerous synthetic biodegradable polymers are available and still being developed for sustained and targeted drug delivery applications.
- Development of such an optimized drug delivery system using biodegradable polymers can offer significant improvement in patient comfort and compliance.
- These systems in many cases reduce the dose intake and thus unwanted toxicities, as well as providing better therapeutic efficacy owing to continuous availability of drug in the therapeutic ranges over a long period of time.
- Microspheres and implant systems have taken the lead in realizing the potential of biodegradable polymeric delivery systems.
- Development of these systems may prove to be a turning point for a large number of macromolecules such as proteins and peptides, as well as for other molecules that are deemed to be active but not deliverable or too toxic.
- However, need to be addressed to extend the benefits of biodegradable drug delivery systems to a large group of drugs and therapeutic conditions.

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