POLYMER

CONTENT

- ✓ Introduction
- ✓ Classification of polymer
- ✓ Mechanism of drug released from polymer
- ✓ Properties of polymer
- ✓ Advantages of polymer
- ✓ Disadvantages of polymer
- ✓ Role of polymer in drug delivery system
- ✓ Application of polymer in controlled drug delivery system

INTRODUCTION

The word polymer comes from greek origin poly means **"many"** and mers means **"parts"**, polymer is defined as chemical substance of high molecular mass formed by combination of large number of simple molecule called monomer. Polymer are macro molecule due to their large size.

HOW POLYMER ARE MADE?

Polymer are very large molecule when hundred of monomer are joined to form long chain.

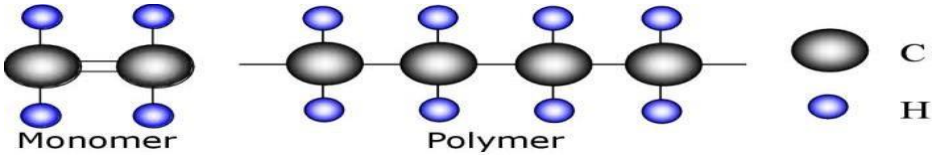
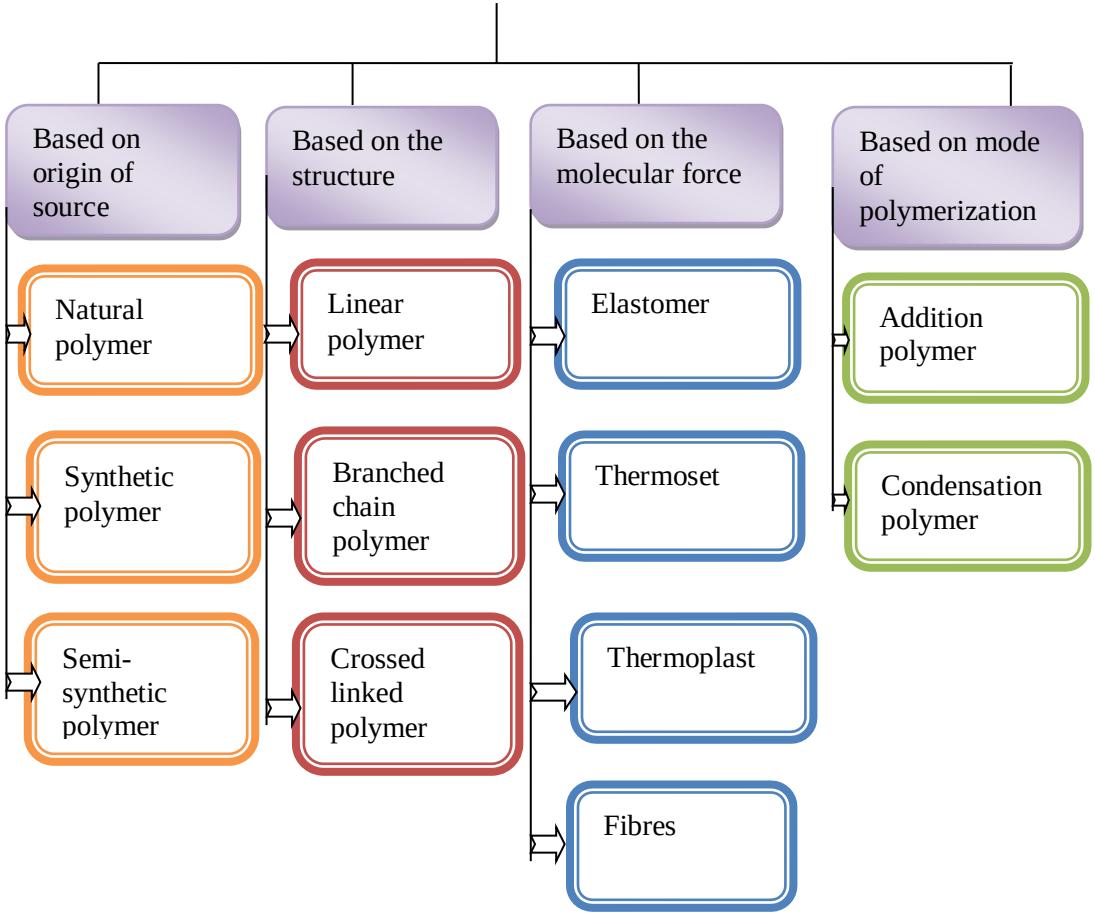


Fig.1 polymerization

Fig.2 polymer in medical field

Fig.3 Polymer in daily life

CLASSFICATION OF POLYMER



BASED ON THEORIGINOFSOURCE

Wood **Rubber** **DNA**

Fig.4 Natural polymer

Teflon **Nylon**

Fig.5 Synthetic polymer

BASEDONTHESTRUCTURE

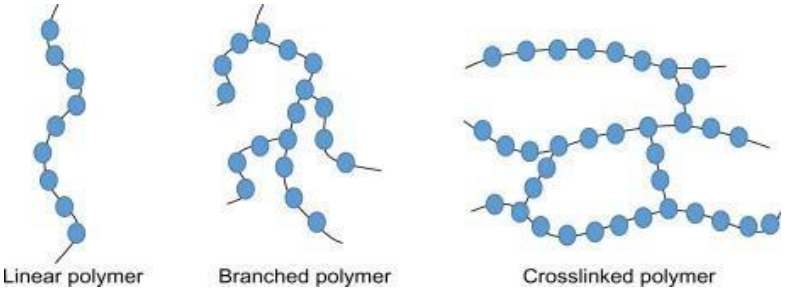


Fig.6 linear polymer, branched chain polymer
Crossed linked polymer.

BASEDONTHEMOLECULARFORCES

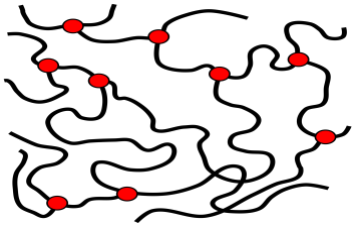


Fig.7 Elastomer

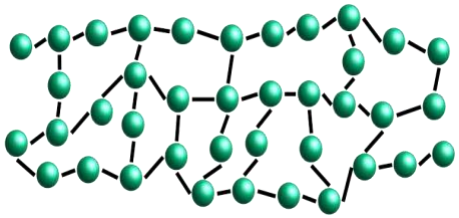
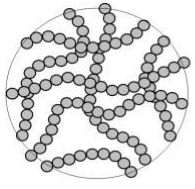


Fig.8 Thermoplast



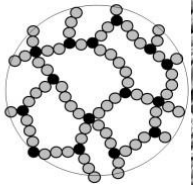


Fig.9 Thermoset

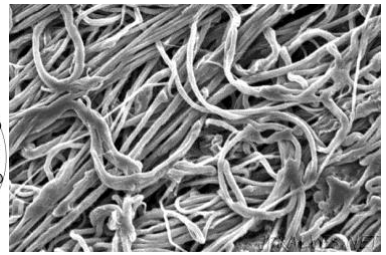


Fig. 10Fibers

BASEDONMODEOFPOLYMERIZATION

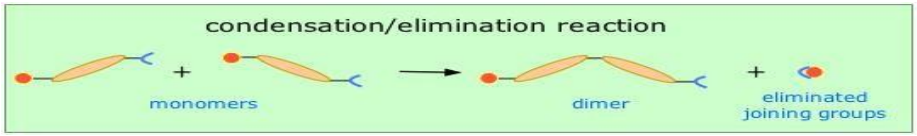


Fig14.Condensation polymer

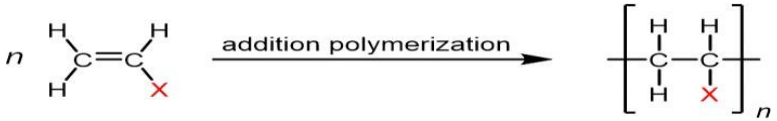


Fig.11 Addition polymer

MECHANISM OF DRUG RELEASE FROM POLYMER

Three primary mechanism for drug release:

- Diffusion
- Degradation
- Water penetration

1) DIFFUSION

There are two type

A) Reservoir type

B) Matrix type

A) RESERVOIR DIFFUSION SYSTEM

In this the drug is contained in core, which is surrounded by a polymer membrane, and is released by diffusion through this rate controlling membrane.

For example, poly (N-vinyl pyrrolidone), poly (ethylene –co-vinyl acetate).

B) MATRIX DIFFUSION SYSTEM

The drug is release is either by the passing through the pores between polymer chain. these are the process that control the release rate.

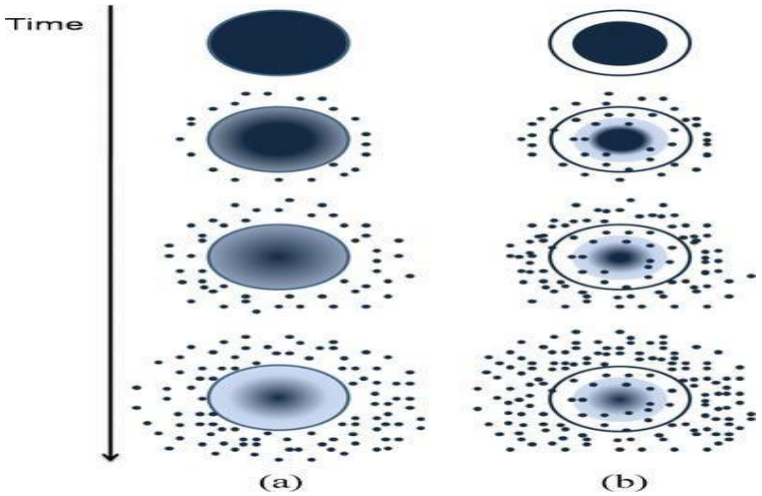


Fig.12 reservoir matrix diffusion system

2) DEGRADATION

The drug molecule which are dispersed in the polymer are released as the polymer start eroding or degrading.

Examples

Biodegradable polymer polylactic acid poly anhydrides.

3) WATER PENETRATION

Swelling increases aqueous solvent content within the formulation of polymer mesh size enabling the drug to diffusion through the swollen network into external environment

Example ethylene vinyl alcohol.

IDEAL PROPERTIES OF POLYMER

- Poor temperature resistance
- Low mechanical property
- Excellent surface finishing
- Poor tensile strength
- Can produced in different colour
- Produced in dimensional manner
- Low coefficient to friction
- Low density
- Good moulding ability

ADVANTAGES OF POLYMER

1. • Make drug available in response to stimuli
2. • Favourably alter bio diffusion
3. • Improve the patient compliance
4. • Reduced side effect
5. • Direct delivery of drug
6. • Biodegradable
7. • Decrease in dosing frequency
8. • Sustained delivery of drug
9. • Localise delivery of drug

DISADVANTAGES OF POLYMER

- ✓ High initial drug release
- ✓ Low mechanical property
- ✓ Strength size ratio is low
- ✓ Low mechanical property
- ✓ Cannot withstand very high temperature
- ✓ Heat capacity of polymer is very less so cannot be used in heat application
- ✓ Exhibit the dose dumping.

ROLE OF POLYMER IN DRUG DELIVERY

1)IMMEDIATE DRUG RELEASED DOSAGE FORM

Polymer such as polyvinyl pyrrolidone and hydroxypropyl methyl cellulose are found to be good binder which increases the formulation of granules that improve the flow of tablet. Starch and cellulose are used as a disintegrate a tablet preparation non-functional polymeric film coated in order to protect the drug from degradation.

Many of the polymeric excipients used to bulk out capsule fill are those same as the used in the intermediate release tablet for hard and soft shell gelatin is the most often used by recent advances HPMC has been accepted as alternative material to the hard and soft capsule. Capsule used as alternative to tablet poorly compressible material to increase bioavailability.

2) EXTENDED RELEASED DOSAGE FORM

Extended and sustained release dosage form prolong the time that systemic drug level are within the therapeutic range and thus reduced the number of dosage the patient must take to maintain a therapeutic effect there by increasing the compliance.

The most commonly used water insoluble polymer for extended release application are the ammonium ethacrylate copolymer, cellulose derivative, ethyl cellulose, ethyl cellulose and cellulose of acetate, and polyvinyl derivatives, polyvinyl acetate.

Eudragit RS and RN differ in the proportion of quaternary ammonium group, rendering the eudragit RS less permeable to water, where as methyl cellulose is available in number of different grades forming stronger and more durable film.

3) GASTRORETENTIVE DOSAGE FORMS

Gastro retentive dosage forms offer an alternatives stratagy for achieve in extended released profile, in which the formulation will remain in the stomach for prolonged periods. releasing the drug insitu, which will then dissolved in the liquid content and slowly passed into the small intestine. unlike the conventional extended released dosage form which gradually released the drug during the transit time along the gastrointestinal tract. such delivery system would overcome the problem of drug that are absorbed preferentially from dosage form with in gastrointestinal tract.

4) MODIFIED-RELEASE DOSAGE FORM

It is now generally accepted that for many therapeutic agent drug delivery using immediate release dosage form result sub optimal therapy and systemic side effect pharmaceutical scientist have attempted to overcome the limitation of conventional oral dosage form by developing modified release dosage form.

APPLICATION OF POLYMER IN CONTROLLED DRUG DELIVERY SYSTEM

ORAL DRUGDELIVERYSYSTEM

Drug released at controlled rate when administered orally. For that several mechanism are involved.

- Osmotic pressure controlled GI delivery system
- Gel diffusion controlled GI delivery system
- Mucoadhesive GI delivery system

OSMOTIC PRESSURE CONTROLLED GI DELEVERY SYSTEM

Semi-permeable membrane is made from biocompatible polymer.

Eg. Cellulose acetate

In this device osmotic agent is contain within a rigid housing and separated from active agent compartment.

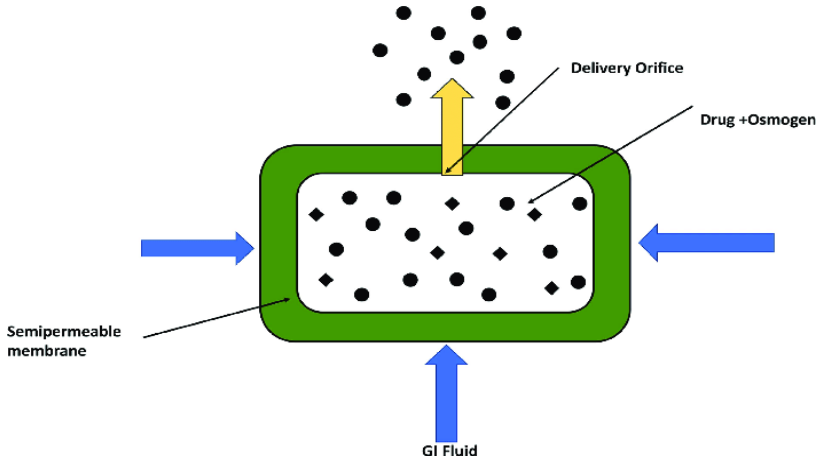


Fig.13 Elementry osmotic pump

GEL DIFFUSION CONTROLLED GI DELEVERY SYSTEM

Gel diffusion controlled released system diffusion and dissolution-controlled system Drug in en cased in particular soluble membrane.

Eg. Ethyl cellulose and PVP mixture dissolved in water and create pores of insoluble ethyl cellulose membrane.

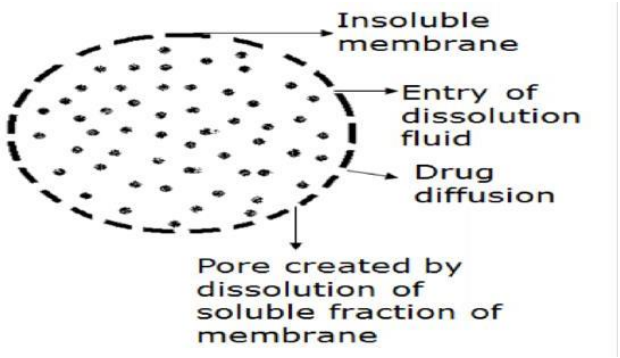


Fig.14 Gel diffusion controlled GI delivery system

MUCOADHESIVE DRUG DELEVERY SYSTEM

The new generation muco adhesive polymer for buccal drug delivery with advantage of increased in residence time, penetration enhancement, site specific adhesion and enzymatic inhibition, site specific muco adhesive polymer will utilized for buccal delivery of therapeutic compound.

Eg.1)Hydrophilic polymer- PVP, Methyl cellulose, Hydroxy propyl methyl cellulose.

2) Hydrogel- carbopol, polyacrylate,eudraight analogue,tragacanth, gelatin, pectin, cellulose derivatives.

- **TRANSDERMAL DRUG DELIVERY SYSTEM (TDDS)**

The use of polymers for skin preparations is manifold. Requirements of such polymers are dependent on the formulation types. The most applied polymers on skin long to various classes, for example to cellulose derivatives, chitosan,carageenan, polyacrylates, polyvinyl alcohol, polyvinyl pyrrolidone and silicones. They are gelating agents, matrices in patches and wound dressings, anti nucleants and penetration enhancers. Correlations between commercially available products and results of new scientific investigations are often difficult or not possible, because of the lack of comparative data especially for transdermal patches. Finally, two promising future trends of polymeric systems, gene delivery and tissue: engineering, are discussed.

- **OCCULAR DRUG DELIVERY SYSTEM**

It allows prolong contact with corneal surface of eye. Example is Pilocarpine in the treatment of glaucoma.Example is polyacrylic acid,copolymer of acetate vinyl and ethyl.

The delivery of therapeutic agents to the eye for the treatment of disorders of the eye, (e.g., glaucoma), using conventional drug delivery systems, e.g. drops, ointments, is an inefficient process.The efficiency of ocular drug delivery is improved through the use of polymeric implants that are implanted under the lower cul-de-sac of the eye. In this system pilocarpine is dispersed within an alginic acid matrix which is sandwiched between two layers each composed of poly(ethylene-co-vinyl acetate). It is designed to release either 20 µg/h or 40 µg/h of a therapeutic agent for a seven day period implantation.

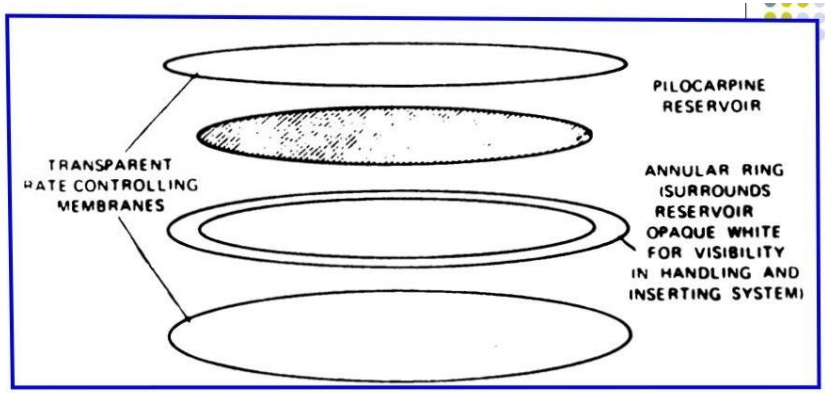


Fig.15 Occular drug delivery system

- **OTHER APPLICATION**

1) DRUG DELIVERY IN THE TREATMENT OF DIABETES

Here the polymer will act as a barrier between the bloodstream and insulin

Example . polyacrylamide or N-N Dimethyl amino ethyl methacrylate.

DRUG DELIVERY OF VARIOUS CONTRACEPTIVES AND HARMONES

Medroxy progesteron acetate-vaginal contraceptives ring it consist of drug reservoir and polymer coating material.That controls the saturation of liquid mediated capsulated in polymeric layer which controls the concentration and released of drug into the blood stream. Example. medroxy progesterone acetate, progestasert, duromine.

2) APPLICATION OF POLYMER IN SOLID DOSAGE FORM

IN TABLETS

Polymer like methyl cellulose, hydroxyl ethyl methyl cellulose are used as binders. Polymer like all the cellulose derivatives are used as a coating material. Polymer like carboxy methyl celllose derivatives are used as a disintegrating agent.

IN CAPSULE

Gelatine a natural polymer which is the major ingredient in the manufacturing of the capsules.

3) APPLICATION OF POLYMER IN THE LIQUID DOSAGE FORM

IN SUSPENSION

Polymer like acacia, tragacanth, cellulose derivatives, xanthum gum are used as a suspending agent.They should be selected based on the character like PH, solubility and concentration. They enhance the dispersion of the solid in liquids.

IN EMULSION

Polymer like tragacanth span, tween are used as emulsifying agent.

4) Polymer can be used as film coating agent to mask the unpleasant taste of the drug and to modify drug release.

5) Hyaluronic acid is used in the controlled released ophthalmic preparation.

6) Some of the polymer using as protective colloids to stabilize suspension and emulsion.

▪ REFFERENCE

- Deepak Jen, Bhaskar Mohite, Nandu Kayande, Journal of pharmaceutical science and medicine,volume 4, issue. 10, October 2019, page no.1
- Dr. K Jesindha Beyatricks Mrs.Ashwini Joshi Novel drug delivery system nirali prakashan page no.1.24-1.26.
- Dr. Shubhash V.Deshmane,Dr.Kailash R. Biyani, novel drug delivery system pee.v Prakashan page no.29
- Shraddha tomar, Lalit Singh,International research journal of pharmacy, volume 7 page no.10
- Dr.K Jeshandha beyatricks,Mrs.Ashwini Joshi, novel drug delivery system Nirali prakashan page no.1.16

PREPARED BY: Miss. Priyanka Morade
Mr. Mayur Kasabe

MENTOR: Dr. Shubhrajit Mantry

DEPARTMENT: Pharmaceutics

SUBJECT: Novel Drug Delivery System

CLASS: Final Year B Pharm

ACADEMIC YEAR: 2021-2022