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A Review on Role of Polymer in Pharmaceutical Drug Delivery System.

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Abstract:
This review article focuses on polymers of therapeutic agents used in pharmaceuticals. These dosage forms include e.g tablets, patches, tapes, films, semi-solids and powders. As such,polymers are the backbone of pharmaceutical drug delivery systems check the release of the drug from the device. Biodegradable polymers draw attention to its use because they can degradeBased on a biodegradable polymer, non-toxic monomers and, most importantly, a constant drug release rate can be achieved. controlled release device. Natural polymers can be used as a tool to achieve predetermined drug release rates and these Physicochemical properties and easy availability create a platform for its use as a polymer in drug delivery systems. Biodegradable polymers have been widely used in biomedical applications due to their known biocompatibility and biodegradability In the biomedical field, polymers are often used as implants and are expected to function for a long time. These improvements improve the effectiveness of treatmentand minimize side effects and other types harm to patients. The main function of the polymer is to protect the drug from the physiological environment and prolong the release of the drug improve its stability. The drug is released from the polymer by diffusion, degradation and swelling. In addition to this review presents Properties and behavior of plant-based and mucoadhesive polymers currently used for drug delivery.

Keywords: Polymer, Tablet Capsule, Polymer based drug Delivery System

Introduction:

Polymers are substances with a large number of molecules soft masses and a large amount are compressed repeating items. Polymers can form solid particles dosage form and can also changethe flow property liquid dosage form. Polymers are the backbone Pharmaceutical delivery systems. Polymers have used as an important tool in drug administration the rate of release of thepreparation. [1] They are too mostly used as a stabilizer, seasoning and preventive agent. Modern advances in drug delivery are is now based on the rational design of polymers specially adapted cargo and designed to work clearly biological functions. Polymers are both naturally occurring and synthetic. Naturally occurring polymers are proteins, starch, latex cellulose. Synthetic polymers are produced in large volume and have many functions and used. Polymers for the drug delivery system are classified according to the following characteristics:

Origin - polymers can be natural or synthetic, or a combination of both.
Chemical nature - based on butter protein, polyester, cellulose derivatives etc.
Physical stability- Polymers can be biodegradable or non-biodegradable.

Solubility- The polymer can be hydrophilic or hydrophobic in nature. (poly4 [2-6])

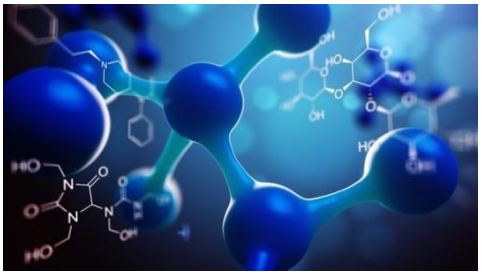

Fig 1[7]

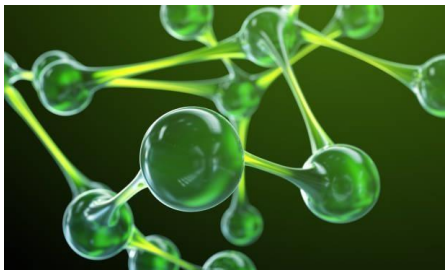

Fig 2[8]

Polymer

History:

The use of polymers in the medical field is not new - natural polymers are used as components herbal medicines for centuries. When it comes to synthetics however, the situation is completely different for polymers. Because polymer science is a relatively new field of research synthetic water-soluble polymers such as macromolecules drugs or as part of related drug delivery systemsvaccination can be considered a modern achievement. The first polymer-drug conjugates appeared around 1955. is a mescaline-N-vinylpyrrolidine conjugate above all. A decade later, Frank Davis and Abraham Abuchowski could foresee the potential conjugation of poly(ethylene glycol) (PEG) to proteins caused by a technique called PEGylation. PEGylation consists of a covalent bond of polyethylene.glycol) polymer chains with another molecule, usually a drug or a protein with a therapeutic effect. In 1994, the first synthetic polymer-drug conjugate appeared.

which was designed to treat cancer, was cline tested It consisted of HPMA (N-(2-hydroxypropyl) methacrylamide) doxorubicin copolymer conjugate. Cancer drugs can also be released in a targeted manner using block copolymer micelles that have the ability stick or covalently bind to the drug. In the 21st century, two polymer-protein conjugates (PEG-interferon-α (targetedantiviral drug for the treatment of chronic hepatitis C and B and PEG-GCSF (PEG-granulocyte colony stimulating factor). to the market and five years later the first treatment nanoparticles (albumin-encapsulated paclitaxel). approved for the treatment of metastatic breast cancer. Everything the achievements and researches mentioned above were the core an element that led to the development of a polymer-based substance drugs, namely polymeric drugs, polymeric drugs conjugates and polymer-protein conjugates. Clinical experiments with these new technologies will eventually lead solution to many other unexpected challenges appeared quickly, as a production polymers on an industrial scale both rapidly and completely dissolution of drugs for safe vaccination. Optimization of these clinical tests (in terms of dose and frequency) are still widely appreciated different products.[9]

Classification of polymer:

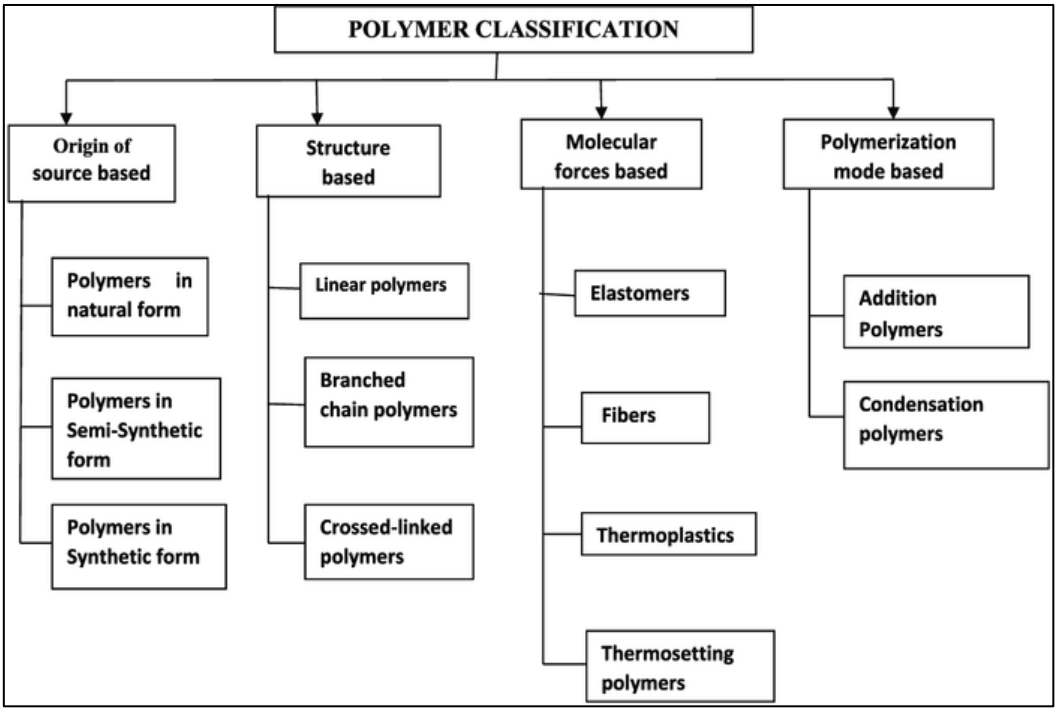

Fig 3[10]

Role Of Polymer In Drug Delivery System:

Immediate release dosage forms:

Tablet:

Polymers have been used as excipients for many years either conventional immediate-releaseoral formulations to facilitate the manufacture or protect the drug against degradation duringstorage. Microcrystalline cellulose often used as a carbohydrate alternative diluents in highlyeffective low dose tablets medicines Starch and cellulose are used as disintegrants tablets thatswell on contact with water, causing the tablet to "explode", increasing exposure surface area of the drug and improves dissolution compositional properties. Including polymerspolyvinylpyrrolidone and hydroxypropylmethylcellulose (HPMC) also find use as binders tohelp shape granules that improve flowability and compaction properties of tablet preparationsbefore tablet. Sometimes dosage forms must be covered with "non-functional" for the protectionof polymer film coatings a disintegration of the drug, the mask has an unpleasant taste drug orexcipients or improve visual elegance without affecting the drug release rate. [11]

Capsule:

Capsules are used as an alternative to tablets, badly compressible materials to mask some bitter tastes drugs or sometimes to increase bioavailability. A lot polymeric excipients used to fill capsules. are the same as those used in immediate release tables. Gelatin was used almost exclusively as a peel material for

hard (two-piece) and soft (in one piece) capsules HPMC is newly developed and approved as an alternative material in production from hard (two-part) capsules.

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Modified Release Dosage Form:

It is now generally accepted that many therapeutic by administering the drug as an immediate- release dose forms lead to suboptimal treatment and/or systemic side effects Pharmaceutical researchers have tried overcome the limitations of conventional oral dosing forms by developing modified release dosage forms.

Extended Release Dosage Form:

The therapeutic effect of drugs that have a short the biological half-life can be extended by their formulation in sustained or slow-release dosage forms. Expanded and slow-release formulations extend this time systemic drug levels are in the therapeutic range and thus reducing the number of doses the patient takes maintain the therapeutic effect and thus increase fulfillment Most commonly used, insoluble in water Polymers for sustained release applications are ammonium tetraacrylate copolymers (Eudragit RS and RL), cellulose derivatives ethyl cellulose, cellulose acetate and polyvinyl derivative, polyvinyl acetate. Eudragit RS and RL differ in the proportion of quaternary ammonium groups, makes Eudragit RS less permeable to water Ethyl cellulose is available in several different grades with different viscosities resulting in higher viscosity classesstronger and more durable films.[12]

Gastro retentive dosage forms:

Gastroretentive dosage forms offer an alternative strategy to achieve an extended release profile the preparation remains in the stomach for a long time in episodes releasing the drug on the spot, so what dissolves in liquid content and drains slowly in the small intestine.[13]

Types of polymer drug delivery system:

Polymers for drug delivery in tissue engineering:

Several strategies have been developed for this purpose restores functional tissue, most of which requires the use of specially designed polymer scaffolds to control tissue growth. The cell transfer method is one of the most commonly used cartilage and bones [14] polymer matrices, both natural and synthetic can play an important role in the supply of proteins for growth factors and cytokines to promote angiogenesis and tissue reconstructive procedures. These molecules areessential tissue growth because they regulate several important cells including reproduction and differentiation. This was demonstrated by careful polymer selection and processing method, controlled release matrices contains proteins and growth factors that induce and can cause tissue growth. Future use Gene therapy as a way of tissue regeneration is exciting field and still in its infancy it can be done yet provides a solution to the drug delivery challenge and proteins more effectively in all fields of medicine[15]

Polymers used in mucoadhesive drug delivery systems:

New generation mucoadhesive polymers for oral treatment benefits of shipping drugs, such as reproduction polymer residence time, increasing penetration, site-specific adhesion and enzymatic inhibition, site-specific mucoadhesive polymers are without a doubt a wide variety of buccals are used

therapeutic compounds. This class of polymer has enormous potential to provide therapeutic treatments macromolecules. Lectin use and "Lectinomimetics" seems to be the most promising field of current research that aims to be safe and effective administration of drugs through the oral mucosa. [16]

Polymers in implantable drugs:

Polymeric microneedles are interesting to implant drug delivery due to their improved biocompatibility and the ability to adapt to the tissue over time without breaking down attachment or tissue reconfiguration processes. These devices are made of several polymers including polydimethylsiloxane (PDMS) ;), polylactic acid and polyglycolic acid (PLGA), a block copolymer hydrogels, SU-8 photoresist and polyimide. Bernard et al 2010 developed a device that includes flexibility and biocompatibility of polymeric micronails providing the benefits of an active fluid delivery devices in a simple microfluidic architecture. This The device uses a similar electrochemical release and dose control mechanism like our previous work(Chung et Erickson), but it is now integrated into a flexible system unlike its predecessor silicon. [17]

Polymer micelles:

In response, polymeric micelles (PM) are developed. direct need for high selectivity of drug carriers.Today, many life-threatening diseases such as the cancer that current chemotherapy still faces the most a major problem related to the lack of selectivity of anticancer drugs towards proliferating cells, leading to cytotoxicity due to the effects of these drugs. PMs were formed from amphiphiles block copolymers are poorly suited for encapsulation water soluble hydrophobic anticancer drugs. Importantly, the critical properties of PM as drug carriers, including particle size, stability, carrying capacity and Kinetics of drug release allows targeting of PMs tumor site with a passive mechanism called enhanced permeability and retentioneffect.[18]

Polymeric nanoparticles as drug carriers :

Some chemical entities break down quickly and/or metabolized after administration (peptides, proteins and nucleic acids). This is the reason for the idea that nanotechnologies can be used to change butter even control the distribution of the drug in the tissues, cellular level or subcellular level was revealed. between technologies used for drug targeting are polymer nanoparticles that were later developed In the early 1980s, as polymer chemistry advanced possible through biodegradable and biocompatible design materials Nanoparticles can be defined as submicron (andlt;1 µm) colloidal systems that typically consist of of polymers. Thus, nanoparticles are colloidal systems whose size is 7-70 times smaller than red blood cells. They can be safely administered intravenously embolization Depending on the method used preparation of nanoparticles, or nanospheres or nanoparticles nanocapsules can be obtained. Nanospheres are matrices systems where the drug is dispersed in the polymer through the particle. On the contrary, nanocapsules are vesicular systems formed by the action of the drug containing a liquid core encapsulated (aqueous or lipophilic). with one polymer film. [19][Data taken From Poly6]

Mechanism Of Drug Release From Polymers :

Diffusion

Diffusion occurs when a drug or other active substance passes through the forming polymer controlled release device. Diffusion occurs when the drug is transferred from the polymer matrix to the ext to the

environment. Publishing continues as usual is reduced in this type of system because the active ingredient the journey has an increasingly long distance and therefore requires a longer diffusion time for release. in these systems, combinations of polymer matrices and The selected bioactive substances must enable the effect of the medicine diffuse through pores or macromolecular structure polymer in connection with the introduction of the dosage system without causing anything to the biological environment change in the polymer itself. [20]

Degradation

A biodegradable polymer breaks down in the body a as a result of natural biological processes, removing the drug delivery system must be removed after the drug is released the active ingredient is ready. Most biodegradable polymers are designed to degrade as a result biological hydrolysis of polymer chains acceptable and gradually smaller compounds. for some degrading polymers, e.g polyanhydrides and polyorthoesters, decomposition present only on the surface of the polymer resulting in a release rate proportional to surface area drug delivery system. [21]

Swelling

At first, they are dry and dry when placed on the body absorb water or other body fluids and swell. The expansion increases the concentration of the aqueous solvent inside composition as well as the mesh size of the polymer that allows the drug spreads through the swollen mesh external environment. [22]

Applications Of Polymers In Drug Delivery :

Application in conventional dosage forms :

1. Tablets:-As binders to mask unpleasant taste for enteric coated tablets
2. Liquids:- Viscosity enhancers For controlling the flow
3. Semisolids:- In gel preparation
4. In Ointments
5. In transdermal Patches [23]

Application in biomedical field:-

A. Water-soluble synthetic polymers :

1. Poly(acrylic acid) Cosmetics, medicines, immobilization of cationic drugs, Carbopol base polymer
2. Poly(ethylene oxide) as coagulant, flocculant, ok high molecular weight up to several million, swelling agent
3. poly(ethylene glycol) MW andlt; 10,000; liquid (Mw andlt;1000) and wax (MW >1000) as plasticizer, base suppositories
4. Poly(vinylpyrrolidone) used to make betadine. (PVP iodine complex), which is less toxic than iodine, plasma substitute, tablet granulation.
5. Poly(vinyl alcohol) Water-soluble packet, tablet binder, tablet coating Polyacrylamide gel electrophoresis separate proteins based on their molecular weight, coagulant, absorbent.
6. Poly (isopropylacrylamide) and poly (cyclopropyl methacrylamide)

B. Cellulose-based polymers :

1. Ethyl cellulose Insoluble in water, but dispersible, aqueous coating system for sustained release

applications
2. Carboxymethyl cellulose Super disintegrating, emulsion stabilizer
3. Hydroxyethyl and hydroxypropyl celluloses
4. Soluble in water and alcohol, tablet coating
5. Hydroxypropylmethylcellulose Tablet binder matrix and tablet coating, gelatin in capsule form of material
6. Cellulose acetate phthalate enteric coating

C. Hydrocolloids:

1. Alginic acid Oral and topical medicine Products; thickeners and suspending agents in different pastes, creams and gels and stabilizer oil-in-water emulsions; binder and breaker
2. Carrageenan: - Modified release, viscosity
3. Chitosan: cosmetics and controlled drug delivery applications, mucoadhesive dosage forms, rapid release dosage forms
4. Hyaluronic acid Reduction of scar tissue, cosmetics
5. Pectinic acid Drug delivery

D. Water-insoluble biodegradable polymers:

Lactide-co-glycol dipolymers Microparticles nanoparticles for protein delivery.

E. Starch-based polymers:

Starch Glidant, diluent in tablets and capsules, a breaker in tablets and capsules, tablet binder Sodium starch glycolate Super disintegrant for tablets and oral capsules.

F. Plastics and rubbers:

1. Polyurethane base of the transdermal patch (soft, comfortable, moderate moisture), blood pump, artificial heart and vascular grafts, foam inside biomedical and industrial products Silicone teats, medical equipment, implants, medical grade adhesive transdermal delivery
2. Polycarbonate body for use in biomedical and pharmaceutical industries Products
3. Polychloroprene septum for injection, pistons injectors and valve components
4. Polyisobutene Pressure-sensitive adhesives transdermal delivery
5. Polycyanoacrylate Biodegradable tissue adhesives surgery, drug carrier in nanoparticles and microparticles
6. Poly(vinyl acetate) Binder for chewing gum.
7. Polystyrene Petri dishes and dishes for cell culture
8. Polypropylene tight packing, heat films, dishes
9. Poly(vinyl chloride) blood bag and tubing.
10. Polyethylene Transdermal patch substrate for drugs adhesive design, packaging, packaging, containers
11. Poly(methyl methacrylate) hard contact lenses dust (hydroxyethyl methacrylate) Soft contact lenses [24]

Polymers In Medicine Delivery The System:

Rosin

Rosin is a film-forming biopolymer and its derivatives is widely appreciated as a pharmaceutical film coatings and microencapsulation materials sustained release of the drug. They are also used in cosmetics, chewing gum and toothpaste. Resin was used prepared by a method based on spherical microcapsules during phase separation by solvent evaporation. Colophon combination with polyvinylpyrrolidone and dibutyl phthalate (30% w/w) produces a smooth film improved elongation and tensile strength.[25-27]

Chitin and chitosan

Chitin is a naturally abundant polysaccharide of mucous membranes and consists of 2-acetamido-2-deoxy-b-D-glucose. You can get chitin chitinase degrades. Chitosan is linear polysaccharide consisting of randomly distributed β-(1- 4)-linked D-glucosamine (deacetylated unit) and N-acetyl- D-glucosamine (acetylated unit). main The property of chitosan in drug delivery is its positive charge in acidic conditions. It is positive charge comes from protonation of its free amino groups. The absence of a positive charge means that chitosan is insoluble in a neutral and basic environment.

Zein

Zein is an alcohol-soluble protein that contains Zeamais endosperm tissue occurs as its by-product corn processing. Zein was used as food food and medical coatings for decades. Zein is cheap and most effective substitute for fast degradable synthetic and semi-synthetic film covers currently used to make substrates allow extrusion coating. [28]

Collagen

Collagen is the most abundant protein in mammals and is the main provider of tissue strength. Just won't do has been studied for use in various operations, cosmetics and drug delivery, but in bioprosthetics and multi-organ tissue engineering.

Starches

It is the main form of green carbohydrate reserve in plants and especially in seeds and underground organs Starch occurs in the form of granules (starch grains) of typical shape and size genre, but also the relationship of content main components, amylose and amylopectin. A several starches have been recognized in the pharmaceutical industry to use These include corn (Zea mays), rice (Oryza sativa), wheat (Triticum aestivum) and potato (olanum tuberosum). oral administration of protein or peptide drugs, microcapsules containing protein and proteinase inhibitor was prepd. Starch / bovine serum albumin Mixed wall microcapsules were prepared using interfacial crosslinking with terephthaloyl chloride. The microcapsules were loaded with native or amine protected aprotinin by adding protease inhibitors in the aqueous phase during the cross-linking process. The protective effect of microcapsules containing aprotinin against bovine serum albumin was demonstrated in vitro.

Polycaprolactone

Polycaprolactone (PCL) is a biodegradable polyester that has a a low melting point of about 60 °C and a glass transition temperature temperature around -60 °C. PCL is made with a ring Catalyst-assisted open polymerization of ε-caprolactone as stannous octanoate. The most common use polycaprolactone is specially manufactured polyurethanes. Polycaprolactones give good water, oil, solvent and chlorine

resistance to polyurethane produced.

Polyorthoesters

These materials have passed through several generations synthetic improvements to materials that can be polymerized at room temperature without product condensation by-products. These materials are hydrophobic with hydrolyzable bonds that are acidic sensitive but stable at bottom. They break under the influence of the surface the rate of erosion and decay can be controlled addition of acidic or basic excipients.

Applications of polymers for controlled drug delivery :

1. Tank systems
2. Ocuser System
3. Matrix systems
4. Release systems that regulate swelling
5. Biodegradable systems
6. Osmotically controlled drug dose
7. Introduction: Principles of Controlled Drug Delivery
8. Progesterase system
9. Reservoir Designed Depot patches
10. Matrix systems
11. Stimulus-responsive release of drugs
12. Ultrasound-sensitive drug release
13. Temperature sensitive drug release
14. pH-sensitive drug release
15. Electric current-responsive drug release
16. Polymer-drug conjugates [29]

Conclusion:

Polymer-based drugs are beginning to be seen key factors in the treatment of many fatal diseases affecting a a large number of people, such as cancer or hepatitis. Although, traditionally, excipients were also added preparations such as inert substances mainly for filling volume and help in the production process, they are increasingly incorporated into dosage forms for special filling features to improve drug distribution because many new drugs have adverse physico-chemical and pharmacokinetic properties. Synthetic polymers can design or modify as per requirements formulation changing the properties of the polymer etc on the other hand there are natural pharmaceutical excipients biocompatible, non-toxic, environmentally friendly and economic Several polymers have been successful are used and others are being studied as excipients planning dosage forms for effective drug dosing.

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