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ROLE OF POLYMERS IN COLON-SPECIFIC DRUG DELIVERY SYSTEMS

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Abstract:

Colon-specific drug delivery systems (CDDS) are designed to deliver drugs selectively to the colon, improving therapeutic efficacy and minimizing systemic side effects. These systems utilize pH-dependent, time-dependent, microbial-triggered, and pressure-controlled mechanisms of the polymers in delivering the drug. Polymers play a crucial role in drug protection and release. In this article we discuss the colon specific drug delivery systems and its approaches briefly.

Keywords: Colon specific drug delivery systems, polymers, pH dependent systems, time dependent systems.

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1. INTRODUCTION:

Colon targeting is useful for inflammatory bowel disease, colorectal cancer, and peptide delivery. The colon provides suitable pH, long transit time, and microbial flora. CDDS are mainly used for treating diseases like inflammatory bowel disease and colorectal cancer, as well as for delivering drugs that are unstable in the upper GI tract. These systems commonly use polymers, which control drug release through mechanisms like pH sensitivity and microbial degradation. Overall, CDDS offer a promising approach for safe and effective targeted drug delivery.

2. Approaches for CDDS

- PH dependent systems release drugs at higher ph.

Time-dependent systems rely on lag time. Microbial-triggered systems depend on bacterial enzymes.

Pressure-controlled systems depend on colonic pressure.

3. Role of Polymers

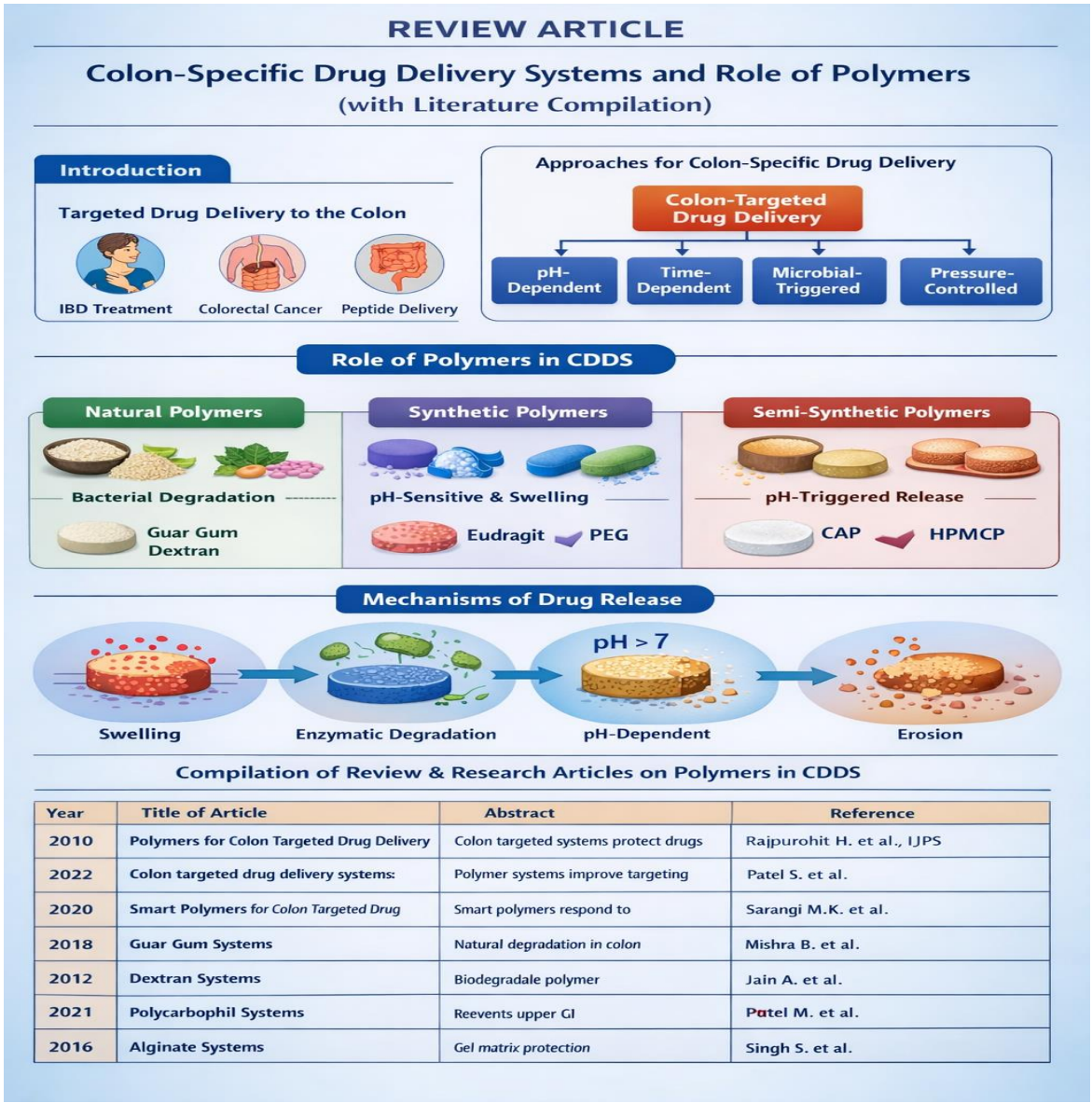
a) Natural polymers: Guar gum, Pectin, Chitosan (microbial degradation)

b)Synthetic polymers: Eudragit, PEG, HPMC (pH-sensitive, swelling)

c) Semi-synthetic polymers: CAP, HPMCP (pH-triggered release)

4. Mechanisms of Drug Release

Polymers in colon-specific drug delivery systems protect the drug in the stomach and small intestine and release it in the colon. They work through mechanisms such as pH-dependent dissolution, swelling, erosion, diffusion, and microbial degradation by colonic bacteria, ensuring targeted and controlled drug release.



Compilation of Review & Research Articles on Polymers in CDDS

Year	Title of Article	Abstract	Reference
2010	Polymers for Colon Targeted Drug Delivery	Colon targeted systems protect drugs	Rajpurohit H. et al., IJPS
2022	Colon targeted drug delivery systems:	Polymer systems improve targeting	Patel S. et al.
2020	Smart Polymers for Colon Targeted Drug	Smart polymers respond to	Sarangi M.K. et al.
2018	Guar Gum Systems	Natural degradation in colon	Mishra B. et al.
2012	Dextran Systems	Biodegradale polymer	Jain A. et al.
2021	Polycarbophil Systems	Reevents upper GI	Patel M. et al.
2016	Alginate Systems	Gel matrix protection	Singh S. et al.

5. Literature search

Year	Title	Abstract	Reference
2010	Polymers for Colon Targeted Drug Delivery	Protect drugs and release in colon	Raj purohit H.
2022	Colon targeted drug delivery systems	Improve targeting	Patel S.
2020	Smart polymers	Responsive systems	Sarangi M.K.
2019	Strategic Approaches	pH sensitive	Various
2011	CDDS Review	Natural polymer's role	Philip A.K.
2018	Polysaccharide systems	Colon degradation	Singh R.
2021	Advances	Nanoparticles improve targeting	Kumar P.
2017	pH polymers	Eudragit dissolves	Patel R.
2016	Microbial systems	Bacteria degrade	Sharma A.
2015	Hydrogels	Swelling release	Verma S.
2023	Smart systems	Precision targeting	Mehta D.
2014	Chitosan systems	Cohesion	Rao K.
2019	Eudragit coated	Prevent stomach release	Gupta V.
2020	Nanoparticles	Improve stability	Das S.
2013	Guar gum	Colon degradation	Mishra B.
2012	Dextran	Biodegradable	Jain A.
2018	Time dependent	Lag release	Singh J.
2021	Combination	phenazines	Reddy P.
2017	Pectin	Biocompatible	Kulkarni V.
2016	Alginate	Gel protection	Thomas L.
2022	Polymer-lipid	Hybrid system	Sharma V.
2015	Coating	Ensures delivery	Ayer S.
2013	Cyclodextrin	Inclusion release	Patel M.
2019	Bio adhesive	Retention	Nair R.
2020	Multiarticulate	Uniform release	Singh K.
2014	Inulin	Natural degradation	Kaur H.
2018	Compression tablets	Delayed release	Patel D.
2023	Stimuli systems	Responsive	Verma N.
2016	Enteric coating	Protect stomach	Gupta S.
2011	Natural polymers	Safe	Desai K.
2012	Azo polymers	Bacterial cleavage	Khan A.
2013	Shellac	GI protection	Reddy M.
2014	Pullulan	Biodegradable	Singh P.
2015	HPMC	Swelling control	Verma R.
2016	Polycarbophil	Bio adhesive	Sharma K.
2017	Xanthan	Colon degrade	Patel N.
2018	Locust bean	Microbial degrade	Ayer P.
2019	Chondroitin	Bacterial degrade	Das R.
2020	Dextran sulfate	Improve targeting	Kumar S.
2021	PEG	Controlled release	Gupta R.
2022	Eudragit S100	Colon pH dissolve	Mehta P.
2023	Dual trigger	pH+enzyme	Singh L.
2012	Calcium pectinate	Enzyme release	Rao S.
2013	Guar gum tablets	Sustained release	Mishra P.
2014	Amylose	Enzyme degrade	Kaur R.
2015	Starch	Natural targeting	Patel H.
2016	Chitosan nanoparticles	Enhance delivery	Sharma D.
2017	Pectin-chitosan	Improved targeting	Singh T.
2018	Alginate-chitosan	Sustained	Kumar V.
2019	Microencapsulation	Polymer coating	Reddy K.

6. DISCUSSION:

Colon-specific drug delivery systems (CDDS) represent a significant advancement in oral drug delivery by enabling targeted release of drugs in the colon. This targeted approach is especially beneficial for treating local diseases such as inflammatory bowel disease (IBD), Crohn's disease, ulcerative colitis, and colorectal cancer, while also improving the delivery of drugs that are unstable or poorly absorbed in the upper gastrointestinal tract.

A key factor influencing the success of CDDS is the selection of suitable polymers. From the reviewed studies, natural polymers such as guar gum, pectin, chitosan, dextran, and inulin are widely used due to their biodegradability, biocompatibility, and ability to be selectively degraded by colonic microflora. This makes them ideal for microbial-triggered drug delivery systems, which are considered highly site-specific. However, variability in microbial population among individuals may affect drug release.

In contrast, synthetic polymers such as Eudragit (L100, S100), polyethylene glycol (PEG), and hydroxypropyl methylcellulose (HPMC) provide more predictable and controlled drug release profiles. These polymers are mainly used in pH-dependent and diffusion-controlled systems. Semi-synthetic polymers like cellulose acetate phthalate (CAP) and HPMCP combine advantages of both natural and synthetic polymers, offering stability and controlled release.

Different targeting approaches have been explored, including pH-dependent, time-dependent, microbial-triggered, and pressure-controlled systems. Among these, microbial-triggered systems are considered more reliable due to the presence of colonic bacteria that degrade specific polymers. However, pH-dependent systems may be influenced by variations in gastrointestinal pH, and time-dependent systems may be affected by differences in gastric emptying and intestinal transit time.

Recent developments in this field, as observed in the reviewed literature, include the use of smart polymers, nanoparticles, hydrogels, bio adhesive systems, and dual-trigger systems. These advanced systems improve targeting accuracy and drug release by responding to multiple physiological stimuli such as pH and enzymatic activity. Multiarticulate systems and microencapsulation techniques also enhance drug distribution and stability.

7. CONCLUSION:

Polymers are essential for targeted drug delivery in colon drug delivery system. Advances in smart polymers and dual- trigger system improve efficiency. sThe polymer selection is vital for the drug delivery system and market success for efficient drug delivery system and cost-efficient formulation to the patient.

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