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A comprehensive analysis of the utilization of chitosan-based nanoparticles loaded with Vancomycin for the purpose of targeted medication delivery in the treatment of Colitis

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Abstract: The project aimed to produce particle formulations based on chitosan (CH) for the transport of vancomycin (VM) to the colon. Different technological procedures were used to prepare chitosan nanoparticles (NPs) loaded with VM. With significant physicochemical and biological characteristics like biocompatibility, biodegradability, nontoxicity, non-immunogenicity, bio adhesion, and antibacterial, antifungal, and hemostatic action, chitosan is a linear polysaccharide. Because of its unique chemical structure, chitosan can be modified in certain ways. It also works well as a drug nanocarrier when chitosan particles are smaller than nanoscale. In this work, tripolyphosphate (TPP) was used as a cross-linker to facilitate the ionotropic gelation process that produced chitosan nanoparticles (CSNPs). The outcomes verified that vancomycin was effectively loaded onto chitosan nanoparticles. Moreover, it has been noted that 40% of the vancomycin is released in bursts during the first nine hours, and that the medication is then slowly released until 90% is released at the hundred-hour.

Keywords: Drug release, Vancomycin, Chitosan nanoparticles, Cross-linker, Polysaccharide

Introduction

N-acetyl-d-glucosamine and (1-4)-linked d-glucosamine are infrequently distributed throughout the linear polysaccharide chitosan. Because of chitosan's advantageous biological characteristics, which include its relative non-toxicity, biocompatibility, biodegradability, cationic properties, bio-adhesive characteristics, and permeability-

enhancing characteristics, chitosan-based particles have been the subject of extensive research for the delivery of anti-cancer agents, therapeutic proteins, genes, antigens, and other substances (Sharma L, et al., 2023). Low molecular weight (LMW) chitosan nanoparticle applications for drug administration and non-viral vector for gene delivery have showed tremendous promise in recent years. This is due to the fact that low molecular weight chitosan exhibits greater solubility, biocompatibility, bioactivity, biodegradability, and even less toxic than high molecular weight chitosan. Additionally, numerous studies have highlighted the impact of size and highlighted the benefits of nanoparticles over microspheres. Chitin can be found in two different allomorphs, namely the α and β forms, depending on its source. Infrared, solid-state NMR spectroscopies, and X-ray diffraction can all be used to differentiate between these forms. The H-bond network in the solid, which controls the solubility, swelling, and reactivity, forms chitin chains. It is present in the cuticle of insects, krill, lobster, crab, and lobster tendons, and is most commonly seen in the α-chitin isomorph. Due to the exceptional thermodynamic stability of this isomorph, α-chitin is also frequently generated by enzymatic polymerization or in vitro biosynthesis through recrystallization from chitin solution (Hafizi Tajuddin et al , 2022) (Younes Islem et al, 2015).

A polysaccharide generated from chitin is chitosan. It is a common natural polymer found in the cell walls of fungi as well as the exoskeletons of crustaceans, insects and other arthropods. depicts a few of the chitin and chitosan sources. Most of the marine chitin used to make the commercially available chitosan comes from sources like the shells of shrimp, lobster, and crab. Chitosan, which is made up of N-acetyl glucosamine and D-glucosamine monomers, is the N-deacetylated form of chitin. Due to its weak water solubility and minimal reactivity, chitin's application is restricted. Chitosan's molecular weight and N-deacetylation level both affect how physiochemically it behaves (E. Mohamed et al, 2020) (Kumar Ritesh et al, 2020).

Chitosan structure, extraction & its derivatives:

A polysaccharide generated from chitin is chitosan. It is a common natural polymer found in the cell walls of fungi as well as the exoskeletons of crustaceans, insects, and other arthropods. depicts a few of the chitin and chitosan sources. Most of the marine chitin used to make the commercially available chitosan comes from sources like the shells of shrimp, lobster, and crab. Chitosan, which is made up of N-acetyl glucosamine and D-glucosamine monomers, is the N-deacetylated form of chitin. Due to its weak water solubility and minimal reactivity, chitin's application is restricted. (Amiji Mansoor et al, 2003).

Chitosan, on the other hand, has a free amino group, which makes it more hydrophilic, water soluble, and capable of more chemical changes. Chitin is processed with a strong NaOH solution to generate chitosan, which is then N-deacetylated (Cerchiara T et al, 2015). The molecular weight and degree of N-deacetylation of chitosan determine its physiological and chemical characteristics. The deacetylation of chitosan can be characterized in two ways: either as the degree of acetylation or deacetylation. The more frequently utilized measure is called the DA, and it represents the ratio of N-acetyl glucosamine monomers to the total amount of polymer units. It is essential because chitosan's characteristics are preferable to those of native chitin because of N-deacetylation. The DA of the polymer differs but it is frequently about 50%. Chitosan has optimal solubility with a DA in the range of 0.45 to 0.55. It can be dissolved in aqueous acidic environments with a DA below 0.7 (Gohel MC et al, 1998).

Chitosan extraction:

I. Chemical Deproteinization
II. Chemical Demineralization

Chemical Deproteinization: The first strategy for deproteinization was chemical. Many different substances, including Sodium hydroxide, sodium carbonate, sodium bicarbonate, have been studied as deproteinization reagents. Each study's reaction conditions are very different. The preferred reagent is Sodium hydroxide, which is used at concentrations between 0.125 and 5.0 M, at temperatures up to 160 °C, and for brief treatments up to several days. When Sodium hydroxide is applied, chitin undergoes partial deacetylation, hydrolysis of the biopolymer, and deproteinization, all of which lower molecular weight. (Gulbake Arvind et al, 2012) (Gohel MC et al, 1998) (Muda S et al, 2013).

Chemical Demineralization: Minerals, typically calcium carbonate, are removed during demineralization. Hydrochloric and nitric acids are two common acids applied in the demineralization process. Among these acids, diluted hydrochloric acid is the ideal reagent. Demineralization is easy to do because it simply involves the breakdown of calcium carbonate into water-soluble calcium salts and the release of carbon dioxide, as shown in the following equation (Genta I et al, 1998).

$$2\,HCl + CaCO_3\ CaCl_2 + H_2O + CO_2 \uparrow$$

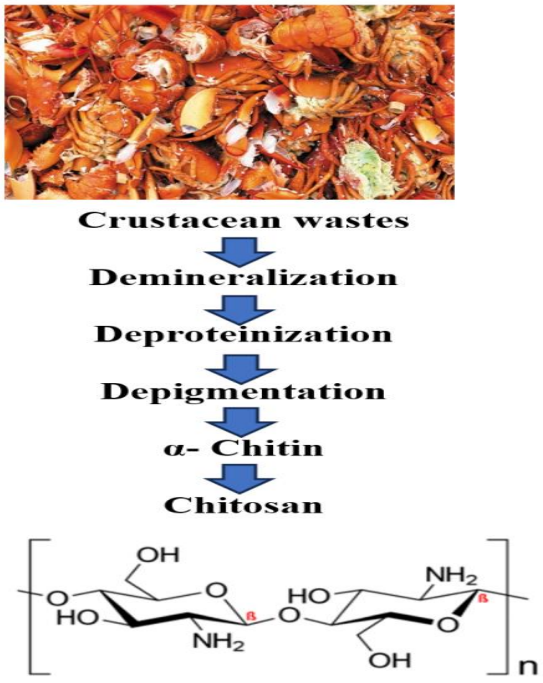


Fig 1: Extraction of α -chitin from marine shell waste (Genta I et al, 1998)

Colon-specific drug delivery: More emphasis has been placed on colon-specific medication delivery in the treatment of colorectal cancer and other colon-related conditions, including Crohn's disease (CD), ulcerative colitis (UC), irritable bowel syndrome (IBS), and spastic colon. In order to avoid the stomach's acidic environment and first-pass metabolism, some drugs, such as those for the heart and digestive system, are also given through the colon. The colon's environment has relatively low levels of proteolytic activity, which has demonstrated the effectiveness of colon targeting for the systemic distribution of protein/peptide medications(Genta I et al, 1998). It is possible to provide medications directly to the colon via mouth or rectal route. Rectal administration techniques, including enemas and suppositories, are not always feasible or efficient because of the significant differences in the way that drugs are administered using this route. Due to their limited dissemination, suppositories are only effective in the rectum, and enema solutions are only useful topically for treating conditions affecting the sigmoid and descending colon. Therefore, the oral route is the most recommended; nonetheless, the main challenge with the oral

route is the absorption and degradation of the active component in the upper section of the GIT, which must be overcome for successful colonic drug delivery. Colon-targeted delivery is now achieved by a number of techniques, including hydrogels and matrices, pH-responsive drug eluting systems, prodrugs that become active at the colon, microflora-activated drug delivery systems, and multicoating time-dependent delivery systems. The main challenges in getting medications reach the colon are absorption and breakdown pathways in the upper gastrointestinal tract. Therefore, all of the aforementioned tactics have made an effort to stop medication loss in the stomach and small intestine, enabling quantitative drug delivery to the colon. It is crucial to comprehend the pathophysiology of the GIT for this reason (Rajesh M et al, 2012) (Younes Islem et al, 2015)

Approaches for CDDS:

Drug Delivery to the Colon via pH-Sensitive Polymer Coating: The pH of the stomach is between 1 and 2 during fasting, but it rises after consuming. The pH of the small intestines approximates 6.5 in the proximal portion and 7.5 in the distal portion. The colon is where the pH begins to decrease dramatically and stays there. It is located about 6.4 in the cecum. However, pH levels as low as 5.7 have been seen in the ascending colon in normal individuals. The pH of the descending colon is 7.0, whereas the transverse colon is 6.6This range of pH values is the basis for the use of pH-dependent polymers. The polymers known as pH dependent polymers in colon specific drug delivery are insoluble at low pH values but become more soluble at higher pH levels. In the gastrointestinal tract and proximal small intestine, a pH-dependent polymer can remain in its formulation; but, in the lower small intestine, it may begin to degrade. This implies that formulations may not be very site-specific. (Kumar Ritesh et al, 2020)

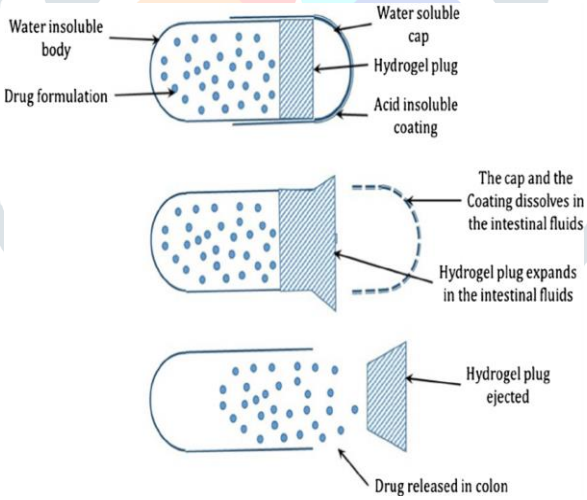


Fig 2: pH Sensitive Polymer Coated Drug Delivery to the Colon (Kumar Ritesh et al, 2020)

Time-controlled release drug delivery system that is delayed to the colon: Time-controlled release drug release systems, such as sustained or delayed release dosage forms, have considerable potential. However, because to the potentially significant variability in the time it takes for dosage forms to be gastrically empty in humans, these algorithms are unable to accurately estimate the colon arrival time of dose forms, which results in limited colonal availability. The dosage forms can also be employed as colon targeted dosage forms by lengthening the lag time by about five to six hours. (Shah et al, 2005)

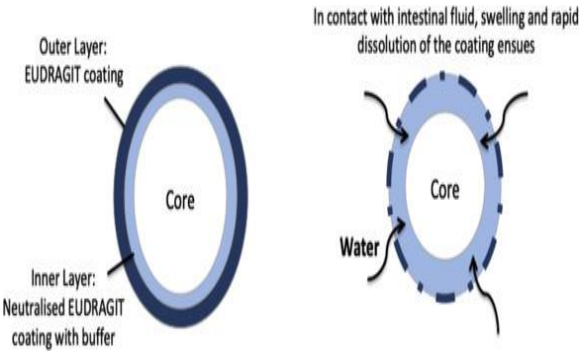


Fig 3: Delayed Release Drug Delivery to Colon(Shah et al, 2005)

Pressure Controlled Drug-Delivery Systems: Because of peristalsis, the colon is subjected to higher pressures than the small intestine. The thickness of the ethyl cellulose membrane is the main element that controls how quickly the formulation dissolves. Additionally, it appears that the system depends on the size and density of the capsules. Because water is reabsorption from the colon, the luminal material viscosity in the colon is greater than in the small intestine. Therefore, it has been established that drug breakdown in the colon may cause problems for oral medicine administration systems designed specifically for the colon. (Gohel MC et al, 1994) (Riberio et al, 2005) (Satishbabu et al,2010).

Novel Colon Targeted Delivery System (CODESTM): A novel CDDS technology called CODESTM was developed to solve the issues that pH and time-dependent systems naturally present. A combination of pH-dependent and microbiologically driven CDDS is called CODESTM. Its specific method, which uses lactulose as a trigger, was created to release medication in the colon at specific locations. The procedure involves coating a standard tablet core with lactulose in two layers: an acid-soluble layer called Eudragit E and an enteric layer called Eudragit L. (Thanou et al, 2000) (Jiao et al, 2002) (Kim S et al 2006).

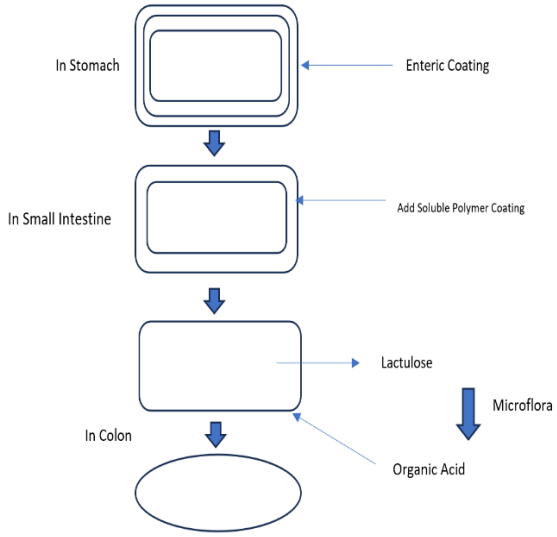


Fig 4: Novel Colon Targeted Delivery System (Kim S et al 2006)

Osmotic Controlled Drug Delivery (ORDS-CT): The OROS-CT can be used to localize a medication to the colon locally during treatment, or it can be used to achieve systemic absorption that would otherwise be unfeasible. One osmotic unit or up to six push-pull units, each having a 4 mm diameter and housed in a hard gelatin capsule, can make up the OROSCT system. In every multilayer push pull device, the drug layer and the osmotic push layer are separated from one another by a semipermeable membrane. Adjacent to the drug layer is a puncture in the

membrane. The push-pull components in the OROSCT dissolve in the gelatin capsule it comes in as soon as it is ingested. Each push-pull unit's drug-impermeable enteric coating prevents it from absorbing water in the stomach's acidic aqueous environment, which makes it difficult to provide medication. (Cerchiara et al, 2003).

Vancomycin:

A peptide medication called vancomycin is prescribed to treat serious, perhaps fatal infections caused by Gram-positive bacteria that do not respond to other, less toxic antibiotics. The history of the glycopeptide antibiotic vancomycin (trade name: Vancomycin) dates back to the **1950s**, when it was found in soil that was produced by the organism **Streptomyces orientalis.** By producing and spreading the material, vancomycin eliminated a large number of potential rival bacterial species and safeguarded the nutrient source that Streptomyces orientalis requires. Following the discovery of vancomycin's activity, scientists studying infectious diseases started investigating the drug's potential use for treating serious bacterial infections in people. But over time, vancomycin became far more widely used in practice due to the emergence of drug resistance, advances in purification, and advancements in drug monitoring tools. The mechanism of action of vancomycin was found through laboratory experimentation (Riberio et al, 2005) (Thanou et al, 2000).

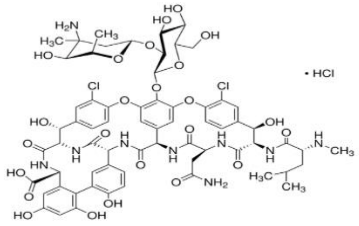
Items	Specification
Chemical formula	$C_{66}H_{75}C_{l2}N_9O_{24}$
Molecular weight	1485.723 g/mol
Appearance	white, crystalline powder
Dissolves	Easily in water, becomes somewhat soluble in ethanol, and becomes insoluble in ethers, acetones, and higher alcohols
Structure	

Table No 1: Physical Characteristics of Vancomycin (Thanou et al, 2000)

Vancomycin Mechanism of Action on Colon:

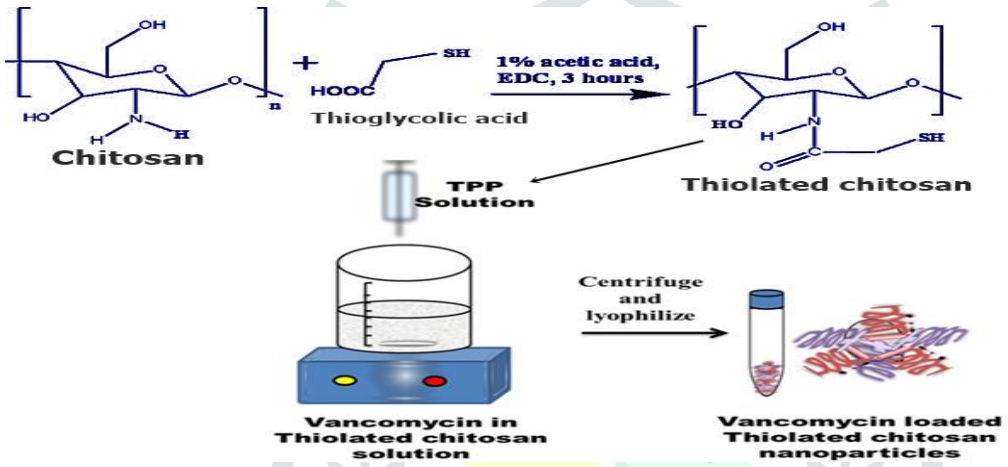
The primary mechanism of vancomycin's antibacterial effect is its suppression of cell-wall production. Vancomycin inhibits the incorporation of N-acetylglucosamine (NAG)-peptide subunits and N-acetylmuramic acid (NAM)-peptide subunits into the peptidoglycan matrix, the primary structural element of Gram-positive cell walls. By creating hydrogen bonds with their terminal D-alanyl-D-alanine moieties, vancomycin inhibits the NAM/NAG-peptide subunits from incorporating into the peptidoglycan matrix. Vancomycin also controls the permeability of

bacterial cell membranes and the synthesis of RNA. There is no cross-resistance between vancomycin and other antibiotics. Vancomycin is not effective against gram-negative bacteria, fungus, or mycobacteria in vitro. (Cerchiara et al, 2002) (Felt et al,1999) (Sekar V et al, 2018).

Vancomycin distribution to the colon using chitosan-based nanoparticles:

More specifically, in recent years, innovative dosage forms containing chitosan particles have been created to treat a variety of colonic disorders, including pseudomembranous colitis, ulcerative colitis, Crohn's disease, and irritable bowel syndrome. This demonstrates that chitosan can improve the bioavailability and absorption of medications (Lee et al, 2006) (Jiao et al, 2002).

Vancomycin is a glycopeptide antibiotic used to treat and prevent severe infections like Clostridium difficile-induced pseudomembranous colitis and other Gram-positive bacterial diseases like Staphylococcus aureus and other species resistant to other antibiotics. However, the acidic environment of the stomach, enzymatic disintegration, prohibited epithelial permeability, and quick gastrointestinal system clearance are the primary barriers limiting the oral administration route of VM. Because of this, intravenous VM injection is necessary for systemic therapy, which has adverse reactions. (Bagre 2013) Archana Patasker et al, 2013). (Bigucci Federica et al,



To increase the oral bioavailability of VM, chitosan/pectin-based micro/nanoparticles and macro gel-based solid dispersion beads have been produced. In particular, nanoparticles provide several benefits as compared to other conventional delivery techniques like tablets and capsules. Particle size is important for colon-targeted administration since smaller particles may pass through mucus layer more easily due to their lower mass. Additionally, as pharmaceuticals encapsulated in nanoparticulate systems are significantly more stable throughout the gastrointestinal tract, the accumulation of nanoparticles may be able to locally transport higher quantities of entrapped therapeutics to the colon, hence boosting therapeutic efficacy (Satishbabu et al, 2010) (Wadhwa et al, 2009).

Preparation of Chitosan Nanoparticles

Low molecular weight chitosan was dissolved at 25 °C by gradually incorporating acetic acid (2 M) and spinning at 9000 rpm in order to produce chitosan nanoparticles. A NaOH (2 M) solution was employed to reduce the pH of the mixture down to 5.5. To get rid of any remaining chitosan, the mixture was filtered using a 0.45-µm cellulose acetate filter.

The 0.25 weight percent TPP solution was made by dissolving the TPP in double-distilled water and then filtered through a 0.25-µm cellulose acetate filter. Three distinct chitosan concentrations (0.1, 0.2, and 0.3 wt%) were synthesized in order to determine the effect of the chitosan-to-TPP ratio on the size of the nanoparticles. Subsequently, 2 ml of TPP at a concentration of 0.2 wt% was added dropwise to 4 ml of chitosan solution using a burette at a rate of 0.2 ml/min. To create the chitosan nanoparticles, TPP solution was added drop by drop to the chitosan solution in CS: TPP volumetric ratios (1:2, 1:3, 1:4). After that, a high-speed stirrer was used to agitate the mixture at room temperature at 9000 rpm. A 20-minute centrifugation was performed on the remaining generated samples, while a portion were used to determine the size of the nanoparticles. The samples were then washed with water and centrifuged again to remove any gradients that had not yet responded. The nanoparticles were then examined after being air-dried at room temperature. Every result that has been released is the average of three test iterations (Wadhwa et al, 2009).

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Fig 5: Preparation of Chitosan Nanoparticles (Wadhwa et al, 2009)

1. **Ionic cross-linking method**: By combining chitosan or its derivatives with oppositely charged macromolecules or in the presence of an ionic crosslinking agent, ionic cross-linking is accomplished using this approach. The most often utilized cross-linking agent is tripolyphosphate. This process is also referred to as the "ionic-gelation method" since ionic linking causes gels to develop (Hafizi Tajuddin et al, 2022).

2. **Covalent cross-linking method:** Covalent bonds develop in this procedure between the functional cross-linking agent and chitosan or its derivatives. compounds that are frequently employed include monofunctional compounds, glutaraldehyde, and polyethylene glycol (Hafizi Tajuddin et al, 2022).

3. **Reverse micellar method :** This process involves adding an aqueous chitosan solution to an organic solvent that contains a surfactant. Agitation takes place in tandem. To keep the combination in the optically transparent microemulsion phase, water is added (Hafizi Tajuddin et al, 2022) (Muxila A et al, 2017).

Loading of vancomycin :

To make vancomycin-loaded CSNPs, 0.5µg/ml of vancomycin was added to a 0.2 mg/ml concentration of chitosan solution. The TPP solution was then combined with the vancomycin-containing chitosan solution at a concentration of 0.45 mg/ml (Thanou et al, 2000) (Jiao et al, 2002).

Characterization :

Using a Fourier transform infrared spectrometer, the interaction between the functional groups in chitosan, chitosan nanoparticles, and drug was evaluated. Applying dynamic light scattering, the size distribution and particle size of the nanoparticles were determined. In order to do this, the solution was immediately put through the DLS test after being sonicated for three hours following the production of nanoparticles (Garg Unnati et al, 2019). (Sekar V et al, 2018)

The prepared samples' melting point, glass transition temperature, and weight loss were ascertained using a thermal gravimetric analyzer and a differential scanning calorimeter. The specimen was heated from room temperature to 300 °C during the test, which was conducted at a heating rate of 10 °C/min with a nitrogen flow rate of 40 ml/min. (Perinelli DR et al, 2018) (Kaur Malkiet et al, 2023).

Evaluation Parameters used for CH- based nano Particle Vancomycin:

1. Dynamic light scattering (DLS): The size and dispersion of chitosan nanoparticles were influenced by numerous aspects, as previously noted, such as the molecular weight of the chitosan, the CS/ Tripolyphosphate (TPP) volumetric ratio, the extra conditions of Tripolyphosphate to chitosan, the concentration of chitosan and Tripolyphosphate, and the pH of agitation rate, ambient temperature, and chitosan. To measure the hydrodynamic diameter in the nanoscale range, DLS technology was applied (Cerchiara T et al, 2003)

2.Synthesis and Characterization: Ionotropic gelation was employed to produce chitosan nanoparticles by adding tripolyphosphate as a cross-linker. After evaluating the effects of chitosan and TPP concentration on chitosan nanoparticle size, a CS: TPP ratio of 1:1 with an average nanoparticle size of around 100 nm was selected. (Bagre Archana Patasker et al, 2013).

3.Drug Loading: The outcomes verified that vancomycin was successfully loaded onto chitosan nanoparticles. Vancomycin is seen to be released 40% in bursts over the first nine hours, and then the antibiotic is released gradually over the next 90% at one hundred hours (Shah et al, 2005)

4. X-ray diffraction analysis: The addition of TPP to chitosan caused the development of amorphous CSNPs, which is why there is a large rise in CSNPs. It follows that the ability of CS chains to fold and crystallize was diminished by the ionic gelation and interactions between CS and TPP (Bagre Archana Patasker et al, 2013).

5. Thermogravimetric analysis (TGA): It is evident that the first weight loss of chitosan, around 3.5%, occurs between 50 and 100 degrees Celsius. This substantial weight loss is linked to the hydrophilic property of chitosan and is caused by the loss of absorbed or bound water. The breakdown begins at 200 °C, and there is a noticeable drop in weight between 200 and 450 °C, which is most likely due to the anhydro-glycosidic ring losing water. At 800 °C, around 22% of the residue is still present at the end of the experiment. The temperature behavior changes, as the chitosan nanoparticle illustrates (Bagre Archana Patasker et al, 2013).

6. Drug release: Three steps of diffusion tests were conducted using CSNPs loaded with vancomycin. There were 100 hours in the trial. By monitoring UV light at regular intervals and converting the results to milligrams, the concentration was determined (Bagre Archana Patasker et al, 2013).

Mechanism Action of Chitosan based Vancomycin on Colon:

By incorporating vancomycin into a chitosan-based delivery system, the antibiotic can be targeted specifically to the colon, where the infection is localized. This targeted delivery can enhance the efficacy of vancomycin against colonic bacterial infections. It to adhere to the mucosal surface of the colon. This property helps in retaining the drug at the site of infection for an extended period, increasing the contact time between vancomycin and the bacteria responsible for the infection. Vancomycin in a controlled manner, either through pH-dependent release or enzymatic degradation. Controlled release ensures sustained therapeutic levels of the antibiotic in the colon, which may be necessary for effectively clearing bacterial infections or reducing inflammation. Delivering vancomycin using a chitosan-based carrier, the inflammatory response associated with colonic diseases such as IBD may be mitigated. This dual action of targeting bacterial pathogens while reducing inflammation can aid in the overall treatment and resolution of colonic diseases. It produces a protective barrier over the colonic mucosa, which may help in preventing further damage to the inflamed or injured tissue. This protective effect can facilitate the healing process and promote the restoration of normal colonic function (Bagre Archana Patasker et al, 2013).

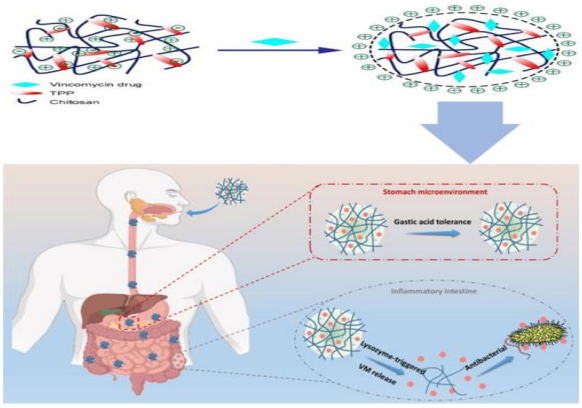

Fig 6 : **Mechanism Action of Chitosan based Vancomycin on Colon** (Bagre Archana Patasker et al, 2013)

Chitosan based and normal vancomycin:

Chitosan based Vancomycin:

The physicochemical and biological characteristics of chitosan, a linear polysaccharide, including its biocompatibility, biodegradability, non-toxicity, non-immunogenicity, biological adhesion, and hemostatic, antibacterial, and antifungal activity. Chitosan becomes an excellent drug nanocarrier when the particle size is reduced to nanoscale. In research, tripolyphosphate (TPP) was used as a cross-linker to create chitosan nanoparticles (CSNPs) using ionotropic gelation. The outcomes confirmed that vancomycin was effectively loaded onto chitosan nanoparticles. Vancomycin is seen to release 40% of its whole dosage in bursts over the first nine hours, and then the antibiotic is delivered steadily over the next ninety to one hundred hours (Sarwar et al,2020)

Normal Vancomycin:

The glycopeptide antibiotic vancomycin inhibits the bacterial cell wall from synthesizing peptidoglycan. It is extremely efficient in reducing gram-positive resistant bacteria. It is not much absorbed by oral and is excreted mostly through the kidneys, where 80–90% of the dose is recovered unchanged in urine in less than 24 hours following oral delivery. Vancomycin has a complex pharmacokinetic profile that can be classified as either compartment or two-part. To minimize infusion-related side effects, the medication is infused intravenously for a minimum of one hour. Vancomycin's tissue distribution, inoculum size, and protein-binding properties all influence its overall efficacy. (Felt et al, 1999).

When combined with chitosan, vancomycin has greater antibacterial activity against both gram-positive and gram-negative bacteria than when taken alone. The combination of the commercial medicine with a naturally occurring bioactive component has a synergistic impact that efficiently inhibits the development of MDR bacteria when compared to the inhibitory effectiveness of the free drug (Berne B et al, 1976).

The polymer chitosan is nontoxic, biocompatible, biodegradable, and bioactive. Vancomycin is administered using chitosan as a drug carrier in drug delivery systems. It is employed in colon concentrated medication administration because of the potential to swell in the intestinal pH but dissolve in the acidic stomach. The colon-specific drug delivery system (CDDS) should protect vancomycin while it is traveling to the colon. This indicates that the bioactive substance should only be released rather than broken down at either of the dissolving sites, and that drug release and absorption shouldn't occur in the stomach or small intestine (Murata Y et al, 1999).

The period of gastric emptying varies significantly among participants or according to the kind and quantity of food consumed. Vancomycin's gastrointestinal transit might alter as a result of gastrointestinal movement, particularly peristalsis, or contraction, in the stomach. Apart from Chitosan if different polymer used Vancomycin loaded nanoparticle for Colon targeted drug delivery formulation therefore it may contract with Colonic environment and

shows toxic result. While achieving colon targeted drug delivery system through chitosan we have to control the pore size of the Vancomycin Nanoparticle formulation. But sometimes pore size controlling might difficulty therefore it is a tedious process (Sekar V et al,2018)

Discussion:

Distribution of drugs can occur locally as well as systemically in the colon. Topical therapy of inflammatory bowel disease is made possible by local delivery. On the other hand, if the medications are able to target the colon directly, the systemic adverse effects can be minimized and the treatment become more successful. This review primarily compares and contrasts the more established methods, such as prodrugs, pH and time-dependent systems, and microbially triggered systems, which have proven exceptional in terms of achieving in vivo site specificity and manufacturing process feasibility, with the more recent approaches, such as pressure-controlled colonic delivery capsules and osmotic-controlled drug delivery.

Conclusion:

The physicochemical and biological features of chitosan, a linear polysaccharide, include biocompatibility, biodegradability, non-toxicity, non-immunogenicity, bio-adhesive, and hemostatic, antibacterial, and antifungal activity. The glycopeptide antibiotic vancomycin prevents the bacterial cell wall from synthesizing peptidoglycan. It is highly effective in killing gram-positive resistant bacteria. The colonic section of the GIT has become more important for drug delivery and absorption. Both local and systemic therapy can be substantially enhanced by CDDS for patients. Systems that use natural materials have a greater possibility of achieving colon selectivity when those natural materials are broken down by the enzymes of colonic bacteria. Given the complexity of colon-specific drug delivery systems and the uncertainty of current dissolution methods in establishing potential in-vitro/in-vivo correlation, pharmaceutical scientists remain faced with the challenge of developing and validating a dissolution method that takes advantage of the physiological features of the colon and can be used regularly in an industrial setting for the evaluation of CDDS.

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