

Formulation and *in-vitro* assessment of a Collagen Peptide Composite Mesh with an Antibiotic for Inguinal Hernia Repair

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ABSTRACT

Hernia is a common surgical procedure that is frequently performed, and there is a demand for effective and biocompatible mesh materials. Standard synthetic meshes are most commonly associated with complications including foreign body response, pain, and infection. Herein we demonstrate the bio-fabrication and *in-vitro* evaluation of an antibiotic-loaded collagen peptide-polymer composite mesh intended to promote better biocompatibility, mechanical strength, and antimicrobial function. The mesh combines collagen peptides with polyvinyl alcohol (PVA) and polyvinyl pyrrolidone (PVP) to give it structural integrity while also including ciprofloxacin for infection control. Characterization approaches such as Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), and water contact angle measurements validate the fabricated mesh's morphology, chemical composition, and hydrophilicity. Tensile strength is maximum with 2.5% polymer concentration, compromising between flexibility and brittleness. Both swelling and biodegradation tests have demonstrated controlled water uptake and degradation for prolonged mechanical support. *In-vitro* release kinetics show 72.01% ciprofloxacin released in the first 24h followed by first order release ensuring effective antimicrobial protection. Antibacterial tests also confirm a considerable inhibition zone against *Staphylococcus aureus* and *Escherichia coli*, indicating sustained bactericidal activity. The biocompatibility, biodegradation and antimicrobial activity of the composite mesh have been improved, and it is expected to be an attractive candidate for replacing traditional synthetic meshes. Advanced fabrication and *in-vivo* studies should be examined for clinical efficacy. This novel method provides a more patient-friendly alternative for the treatment of inguinal hernia repair with fewer complications and better post-surgical effects due to the proper plane strength, biodegradability, and drug-release.

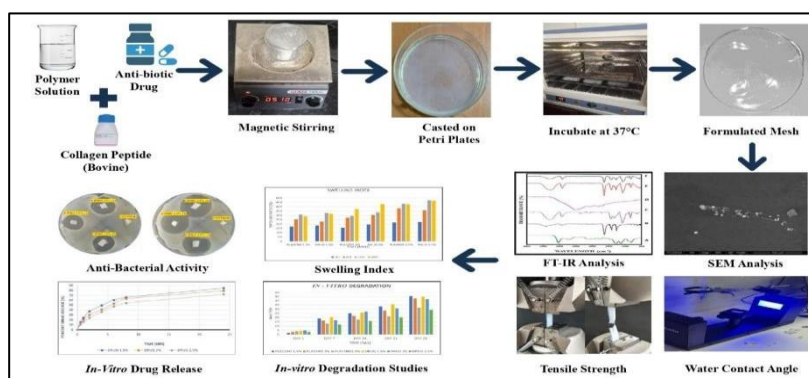


Figure 1: Graphical Abstract

Keywords: Antibiotics, Antimicrobial efficacy, Collagen peptide, Inguinal hernia, Mechanical Strength, Polymers.

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INTRODUCTION

Hernia repair is one of the most frequently practiced surgeries worldwide, and the inguinal hernia is the most common form. The advent of mesh implantation has revolutionized the management of patients by offering structural support and lowering the rates of recurrence¹. Nevertheless, conventional synthetic meshes, composed of for example polypropylene (PP) and polyester (PES), are known to be associated with several complications, such as foreign body reaction, chronic pain, mesh shrinkage and the increased potential for postoperative infections². This shortcoming has enriched the research towards improvement of surgical success and patient comfort through the development of new advanced biomaterials with improved biocompatibility, mechanical stability as well as antimicrobial abilities³. Collagen-based materials are attracting attention, owing to their natural biocompatibility, biodegradability and capacity for cellular integration⁴. In the present study, collagen peptide-polymer combined mesh is developed for the purpose of inguinal hernia repair, in which collagen peptides are conjugated with PVA and PVP to improve mechanical property and elasticity. Also, a broad-spectrum antibiotic (ciprofloxacin) is dispersed in the matrix so as to reduce the risk of bacterial infection, which is one of the major factors of the post-surgical complications⁵. *In-vitro* characterization studies are used to assess the ability of this composite mesh. Surface morphologies and fiber distribution are determined by scanning electron microscopy (SEM), and chemical compositions were confirmed by Fourier transformed infrared spectroscopy (FTIR)⁶. Water contact angle testing provides the measurement of mesh hydrophilicity, a concern of mesh integration. The tensile strength is verified mechanically of the mesh to ensure that it resists physiological forces but remains pliable⁷. Swelling and biodegradation studies are performed to assess the water absorption, degradation rates and structural stability over time⁸. Furthermore, ciprofloxacin release kinetics were evaluated using a Franz diffusion cell system to maintain low ciprofloxacin concentration preventing from bacterial colonization⁹. The antibacterial performance of the mesh is tested towards *Staphylococcus aureus* and *Escherichia coli* with an agar well diffusion assay, thus indicating an obvious inhibition zone, drug-loaded mesh still demonstrating a sustained bactericidal effect¹⁰. Such a combination therapy using collagen peptides, synthetic polymers, and antibacterials has several benefits including better biocompatibility, controllable biodegradability, and excellent antimicrobial function¹¹. The study presented here aims to produce a candidate material which can provide the required mechanical properties and degradation behaviour compared to currently available synthetic meshes. Future works would involve optimization of the process, other manufacturing processes such as 3D printing approaches and evaluation of the clinical performances by performing *in-vivo* studies¹².

2. MATERIALS AND METHODS

Kniss Laboratories, Chennai, generously provided pharmaceutical-grade ciprofloxacin, while Polyvinyl Alcohol and Polyvinyl Pyrrolidone were sourced from Himedia. These high-purity polymers ensured biocompatibility and mechanical stability in the fabricated mesh. Deionized water was used as the solvent to maintain purity and prevent contamination during preparation and characterization. All chemicals were of pharmaceutical grade, eliminating the need for further purification and ensuring consistency in experimental outcomes. The selection of high-quality raw materials enhanced the mechanical properties, biocompatibility, and drug dispersion within the polymer matrix. This ensured the fabricated composite mesh met biomedical standards, making it suitable for further biological and clinical evaluations.

2.1 PREPARATION OF PVA SOLUTION

Weigh the specific amount of polyvinyl alcohol (PVA) from the precision balance to maintain the formulation consistency. Add the weighed PVA into a clean 100 mL beaker that already has 10 ml of distilled water. In order to homogeneously dissolve, 600 mg of PVA is slowly added to the water under stirring. The solution is stirred magnetically and heated to moderate temperature of about 70°C in a magnetic stirrer, to achieve a homogeneous dispersion and complete dissolution of PVA. The moderated heating prevents the deterioration as well as ensures uniformity. The solution thus obtained is stirred until a clear and uniform solution of polymer is prepared, as the understratum of successive mesh formation¹³.

2.2 PREPARATION OF DRUG-POLYMER LOADED COLLAGEN PEPTIDE MESH

Weigh 150, 200, or 250 mg PVP exactly into a measuring beaker, add it to the obtained PVA solution, and stir it with an agitator until it completely dissolved. Add 100 mg of collagen peptide and stir with 2 mL of collagen peptide solution. Add 100 mg of ciprofloxacin to the polymer-collagen solution and mix. The mixture was then cooled slowly to 40°C with constant stirring to avoid air bubble entrapment. The solution was mixed for 30 min at the room temperature, then casted in the Teflon mold and cured at 37°C for 24 h. To maintain mesh flexibility and prevent cracking, complete drying was avoided. Finally, the meshes were carefully peeled from the molds and stored in sealed containers at 4°C to prevent moisture exchange, ensuring long-term stability and usability for biomedical applications¹⁴.

2.3 SCANNING ELECTRON MICROSCOPY

The particle size and surface morphology of polymer drug loaded collagen mesh were observed by Scanning Electron Microscope (TESCAN VEGA3). The mesh was carefully

mounted on a 20×20 mm cover slip by attachment to a stub using double-sided carbon tape. Gently evaporating under room temperature was suitable for imaging. SEM photographs were taken at 100×, 500×, 1000× and 10,000× magnifications for high-resolution images to evaluate the integrity of the structure, the surface properties of the mesh and the homogeneity of the polymer-drug distribution inside the mesh¹⁵.

2.4 FOURIER TRANSFORM INFRARED SPECTROSCOPY

The materials chemical composition was analyzed by means of Attenuated Total Reflectance Fourier Transform Infrared Spectroscopy (ATR-FTIR). The analysis was performed with the Bruker Alpha II FTIR spectrometer, with a 4 cm⁻¹ resolution. All samples were scanned 64 times for accurate spectral data collection¹⁶.

2.5 TENSILE STRENGTH

The specimens will be securely mounted on a jig within the Universal Testing Machine (Instron E300). A uniaxial tensile load will be applied at a constant crosshead speed of 1 mm/min until failure. This analysis will assess the mechanical strength and deformation characteristics of the material under tensile stress¹⁶.

2.6 WATER CONTACT ANGLE

The wettability of the irrigant was assessed by measuring the contact angle using an Ossila goniometer on a prepared dentine slab (4×4×1 mm). A droplet of the irrigant was placed on the sample surface, and the contact angle was determined through image analysis. Photographs of the droplet were captured using a digital camera integrated with the goniometer, ensuring precise measurement. This analysis provided insights into the surface hydrophilicity of the material, which is crucial for evaluating fluid interaction and adhesion properties¹⁶.

2.7 SWELLING STUDIES

The swelling experiment assessed water absorption in PVA-based samples. Dried and weighed meshes were submerged in deionized water, then reweighed after 1, 4, and 24 hours. The swelling ratio was calculated to evaluate hydration capacity, which is crucial for determining the material's stability, flexibility, and potential biomedical applications¹⁷.

2.8 IN-VITRO DEGRADATION

The weight loss data were analyzed to assess the biodegradation behavior of mesh grafts over 35 days. Initial weights (W_i) were recorded, and samples were incubated in a sterile PBS solution (pH 7.4) at 37°C. At specific intervals (1, 7, 14, 28, and 35 days), specimens were removed, rinsed with deionized water, and vacuum dried. Final weights (W_f) were measured to determine the percentage of weight loss. This assessment provided critical insights into the degradation rate, ensuring the mesh maintained structural integrity during the healing phase while gradually breaking down to support tissue regeneration¹⁸.

2.9 IN-VITRO DRUG RELEASE KINETICS

The *in-vitro* drug release of the polymer mesh was evaluated using a Franz diffusion cell. The formulation was placed in the donor compartment containing phosphate buffer and stirred at 50 rpm to maintain uniform conditions. At predetermined intervals, samples were withdrawn, replaced with fresh release medium, and analyzed using a UV-Vis spectrophotometer at 220 nm. The obtained release data were fitted to various kinetic models, including zero-order, first-order, Higuchi, and Korsmeyer-Peppas models, to determine the drug release mechanism. This analysis provided insights into the diffusion behavior, ensuring controlled and sustained drug release for biomedical applications¹⁹.

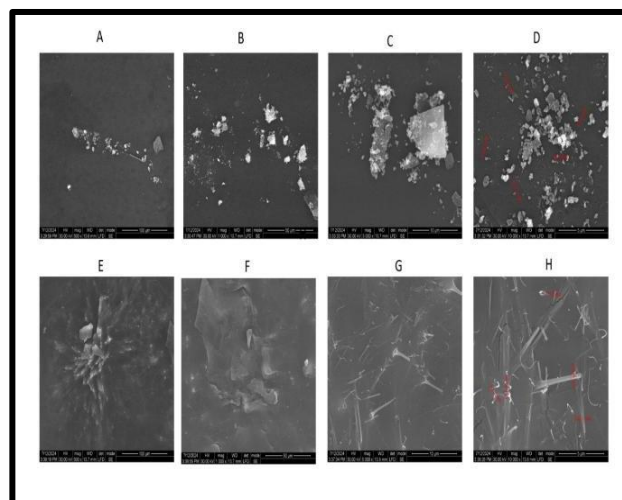
2.10 ANTI-MICROBIAL ACTIVITY

Antimicrobial activity refers to the ability to kill or inhibit disease-causing microorganisms, including bacteria, viruses, and fungi. The agar well diffusion method is commonly used to evaluate the antimicrobial potential of plant or microbial extracts. Muller Hinton agar is prepared, and microbial cultures are inoculated onto the plates. Wells are created, and the test samples are introduced. Following incubation, the zone of inhibition around the wells is measured to assess antimicrobial efficacy. This method helps determine the bactericidal properties of isolated and purified compounds, providing valuable insights into their potential applications in infection control and therapeutic development²⁰.

3. RESULTS AND DISCUSSION

3.1 SCANNING ELECTRON MICROSCOPY

SEM of the placebo hernia mesh material A placebo hernia mesh material, which is composed of PVA, PVP, and collagen peptide through solvent casting, shows particle sizes ranging from 14.6 nm to 118.1 nm and high-magnification images displaying a rough and irregular surface and well-dispersed polymer clusters, which guarantees uniform mechanical properties and a good tissue



incorporation as shown in **FIGURE 2**.

Figure 2: SEM images of Placebo and Drug Loaded Mesh In 500x, 1000x, 5000x, 10000x Magnifications. Placebo (A, B, C, D) And Drug (E, F, G, H)

Images at lower magnifications show a homogeneous distribution of material, while nanoparticles cluster into composite secondary particles, affecting mechanical performance. FESEM shows heterogeneous polymer particle distribution, which emphasizes the necessity of optimization of the cast solvent for uniformity. At 10,000 \times (5 μm), there is observation of a fibrous network (diameter: 62.1–254.8 nm), indicating the homogenous mixing of the polymer matrix preserving the structural integrity of the composite. A moderate magnification (5,000 \times) also shows an interconnected porous network sufficient for cell infiltration, tissue integration and sustained release of Ciprofloxacin for prevention of infection. At higher magnification (1,000 \times , avg. 50 μm), larger surface features such as agglomerates and defects are visible, yet the structure resembles solvent cast polymer meshes. The SEM observation reveals a porous fibrous polymer-drug-loaded mesh demonstrating mechanical stability, biocompatibility and controlled drug delivery. It is necessary to continue to optimize the solvent casting process in order to eliminate defects and to produce a uniform distribution of particles that both improve mesh tensile strength and flexibility, as well as the overall quality for hernia repair applications.

3.2 FOURIER TRANSFORM INFRARED SPECTROSCOPY

Inclusion of certain functional groups into the end hernia mesh composition is a critical factor in its performance and efficacy. The C-O stretching vibration of PVA is observed in the 1078 cm^{-1} band, which substantiates the presence of hydroxyl groups, thereby imparting hydrophilicity, which is also critical for water absorptivity and, consequently, water retention, which ensures that the mesh swells enough to accommodate the surgical site, maintaining moist conditions required for the healing process. The CH_2 bending and C-N stretching vibrations of pure PVP at 1421 cm^{-1} indicated the occurrence of the pyrrolidone ring, which is established as enhancing solubility, biocompatibility, and controlled drug release needed for the efficient delivery of Ciprofloxacin. For collagen peptides groups, C=O stretching in the amide I band at 1703 cm^{-1} guarantees the integrity of peptide bonds, which allow them to become a natural scaffold for cell adhesion, growth, and tissue regeneration, meanwhile maintaining a good mechanical strength and biocompatibility. Last, the O-H stretching vibration and vibration at 3266 cm^{-1} in Ciprofloxacin indicates that its functional groups are not damaged, thus, guaranteeing the anti-infectious property of Ciprofloxacin as mentioned in **FIGURE 3**.

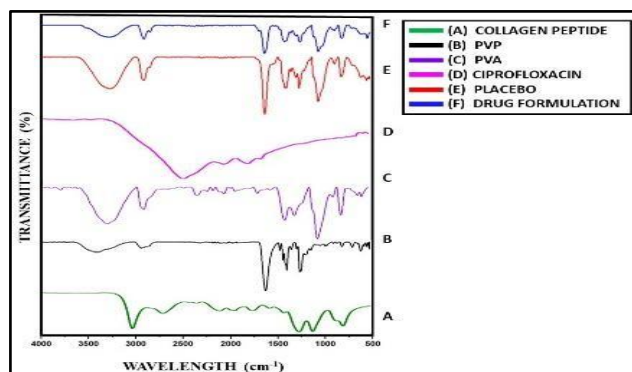


Figure 3: FTIR Combined Graph of A - Collagen Peptide, B -Polyvinylpyrrolidone, C - Polyvinyl Alcohol, D - Ciprofloxacin, E -Placebo, F - Drug Formulation

These functional groups together provide a preferred swelling, structural strengths, biological compatibility, and long-term drug delivery characteristic into the mesh, which can be used as an effective treatment for hernia.

3.3 TENSILE STRENGTH

The measurements of the mechanical properties Stress-strain curves of all the concentrations are presented in Figure 4 calculated from the dry state. Tensile strength evaluation of hernia mesh materials. The tensile strength test of hernia mesh formulations shows that the 2.5% both placebo as well as ciprofloxacin loaded one exhibit good mechanical properties in comparison to 1.5% and 2% strength preparation. Placebo 2.5% 10.80 MPa and Drug 2.5% 13.89 MPa tensile strength, as shown in **FIGURE 4**.

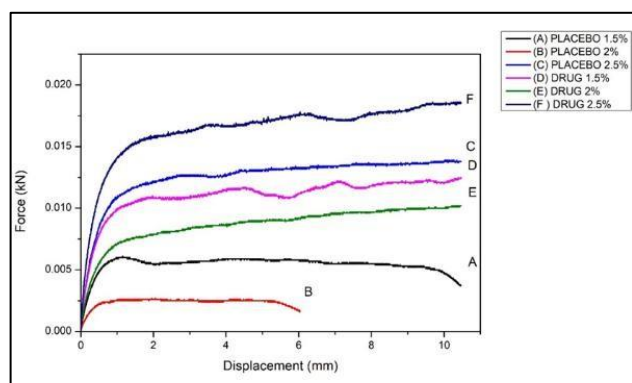


Figure 4: Stress-Strain of PVA-Loaded Drug 1.5%, PVA-Drug 2%, And PVA-Drug 2.5% Specimens for analyzing Tensile Strength

The improved hemostatic effect of this hydrogel at 2.5% concentration may be due to the fine cross-linking network with the average molecular weight of the polymers and the interaction between polymers, increasing the structural integrity and resilience. The excess polymer concentration (2.5%) results in a strong mesh that can withstand physiologic loads. Tensile strength was not compromised with the inclusion of ciprofloxacin, suggesting a screw effect on structural integrity. Lower concentrations (1.5% and 2%), on the other hand, have very low polymer content

to form strong inter-node attractions which lead to weaker mechanical properties. Reinforcement contents above this limit can make the mesh excessively stiff and further impede its flexibility. The 2.5% formula therefore caters for the best combination of the degree of flexibility and strength to offer the required support to avoid rupture of the resultant fibrotic content following hernia repair. Thus, it may be inferred that 2.5% concentration, (both placebo and drug loaded) of gel is most effective in terms of mechanical durability and therapeutic potential.

3.4 WATER CONTACT ANGLE

The wetting process of PVA and drug (1.5%, 2%, 2.5%) loaded grafts was studied by water contact angle (WCA) measurements taken 60 seconds post droplet deposition. The contact angle of each modified drug increased, suggesting lower water absorption and higher surface hydrophobicity. By the sessile drop, the initial contact angles of Drug 1.5%, 2%, and 2.5% were 33.43°, 35.38°, and 37.32°, respectively, which indicates the reduced hydrophilicity of the drug concentration growth. After 60 seconds, the angles were 31.05°, 30.63° and 27.14° as shown in **FIGURE 5**,

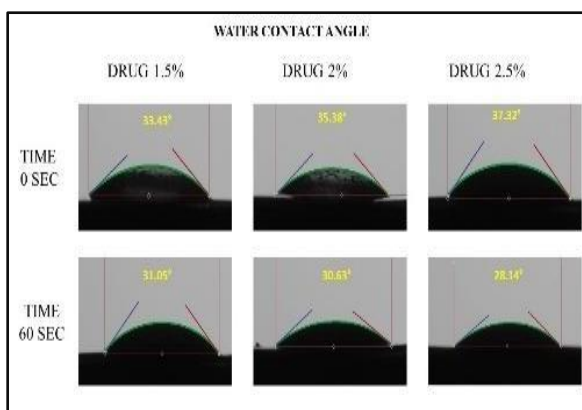


Figure 5: Water Contact Angle Analyzed By an Ossila Goniometer for Drug 1.5%, Drug 2%, Drug 2.5% on 0 Seconds And 60 Seconds

and Drug 2.5% showed the greatest reduction, indicating higher hydrophilicity and water absorption capacity as mentioned in **FIGURE 6**.

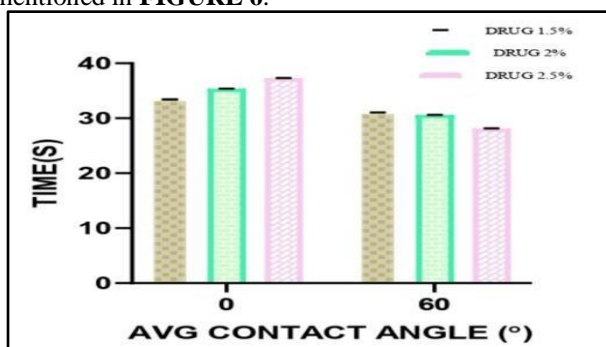


Figure 6: Average Contact Angle (°) Results Presented in Bar Diagram

This improved wettability in Drug 2.5% is pertinent as it promotes tissue integration and reduces postoperative complications. Lower contact angle of Drug 2.5% indicated the optimum polymer and drug load which are essential for tissue interaction/healing. The results suggest that Drug 2.5% is an optimal medicinal formulation for hernia mesh application, which promotes cell adhesion, proliferation, and better clinical performance. All values are less than 90°, indicating the hydrophilicity of the samples is very high owing to the existence of degradable polymers, which is conducive to performance. Optimizing drug concentration in the polymer matrix is essential for achieving the desired balance between hydrophilicity and mechanical stability in hernia mesh design.

3.5 SWELLING STUDIES

The data in **FIGURE 7**

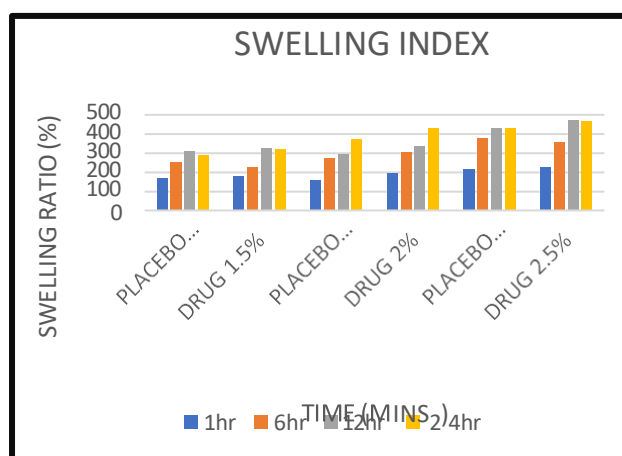


Figure 7: Swelling Study Graph for Placebo 1.5%, 2%, 2.5% and Drug 1.5%, 2% And 2.5%

clearly demonstrate that it is possible to prepare a mesh whose swelling behaviour is greatly affected by both the polymer concentration and the presence of Ciprofloxacin. This fast initial swelling of all the meshes is ideal to ensure instant post-implantation structural integrity and the sustained increase in swelling till 6 hours reflects the meshes' potential for sustained swelling, required for effective drug delivery. Between 3 h and 6 h, the different swelling ratios indicate an equilibrium stage between the hydration of the polymer and the stability of the structure. This is accompanied by the maximum swelling value (475%) over 24 h for the 2.5% PVP concentration in the drug group, which can be interpreted in terms of a more expanded and continuous polymeric web for optimal water absorption and retention. This network holds the particle together, so that a high degree of fragmentation will not occur with added swelling. On the other hand, lower concentration (1.5% and 2%) have lower swelling behaviors, probably because of less developed structures that could not hold the water as the higher concentrations. Swelling capacity was unaffected by the presence of ciprofloxacin, which is well distributed in the polymer network. Therefore, the 2.5% PVP concentration enables a compromise between the swelling potential and structural

integrity, which in turn is very suitable for incorporation of hernia mesh as it can fill the gap in the surgical defect, offer a sustained drug release, and retain its mechanical strength required for successful hernia repair.

3.6 IN-VITRO DEGRADATION

The most significant issue concerning absorbable meshes is the rapid rate of degradation requiring a balance between degradation and tissue in-growth to avoid hernia recurrence. The mesh stability was evaluated by calculating the rate of weight loss at 1, 7, 14 and 28 days as mentioned in **FIGURE 8**.

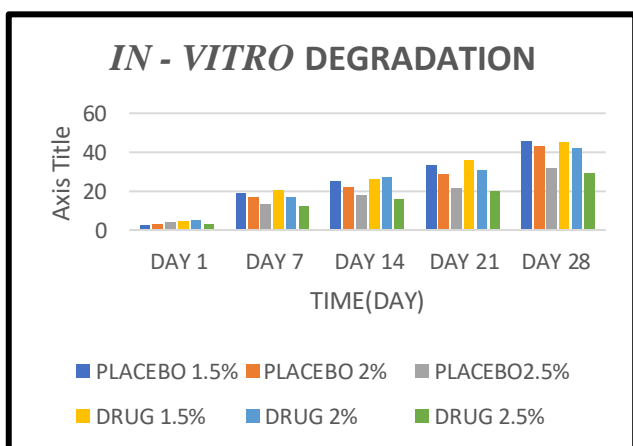


Figure 8: In-vitro Degradation Study Graph for Placebo 1.5%, 2%, 2.5% And Drug 1.5%, 2% and 2.5% on Day 1, 7, 14, 21, 28 Days

The weight loss was enhanced as the exposure time increased, but the degradation rate was strongly dependent on the PVP concentration and the presence of ciprofloxacin. The degradation on Day 1 was within 25 ± 31%–2%–4.5% or less and initial structural support was preserved. The weight loss was of 19–20.4% by Day 7, which was a consequence of the action of a hydrolytic process. By Day 28, the degradation rate of the 2.5% PVP with ciprofloxacin group (29.1%) was the highest, suggesting a favorable resorption and mechanical balance. Lower concentrations of PVP (1.5% and 2%) demonstrated a compromise between reduced degradation efficiency and the possibility of too rapid degradation before tissue regeneration. Swelling, which was also dependent on polymer concentration and ciprofloxacin, indicated that the hydrogel underwent rapid swelling, which is desirable to maintain the structure of the scaffold. Drug 2.5% PVP-time point 24h The maximum swelling ratio was observed for 24h, was 475% compared to other times and explained superior power of swelling by water absorbance and retaining owing to cohesive polymeric networks. This equilibrium provides structural support, long-term drug release, and appropriate filling of the surgical site. The 2.5% PVP with ciprofloxacin formulation exhibits the optimum trade-off between degradation, swelling, and mechanical behavior needed to consolidate healing in hernia repair.

The drug release from the Ciprofloxacin-conjugated hernia mesh over 24 hours was examined and was observed having an initial burst with sustained release which reached 72.01% cumulative release as shown in **TABLE 1**.

TIME (hrs)	DRUG 1.5%	DRUG 2%	DRUG 2.5%
0	0	0	0
0.5	15.34	13.2	10.21
1	23.97	20.92	16
2	37.09	29.87	24
4	49.03	40.76	36
6	59.98	52.54	46.87
8	65.87	63.09	53.89
24	84.45	79	72.01

Table 1: Drug Release Kinetics for all three Concentrations 1.5%, 2%, & 2.5%

This sustained release enhances therapeutic effects by maintaining Ciprofloxacin release for an extended duration as shown in **FIGURE 9**.

Figure 9: In-vitro Release Kinetics of Drug 1.5%, 2% & 2.5% for 24 Hou

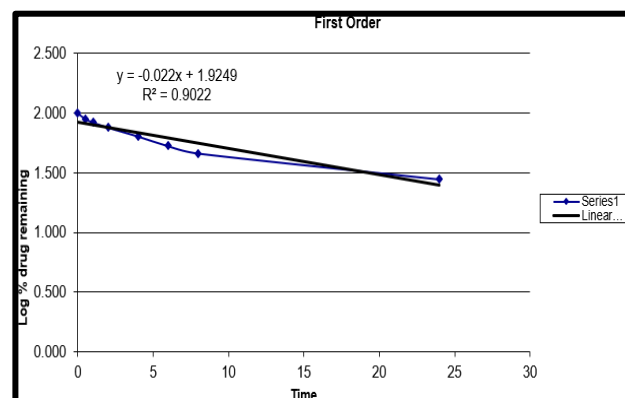
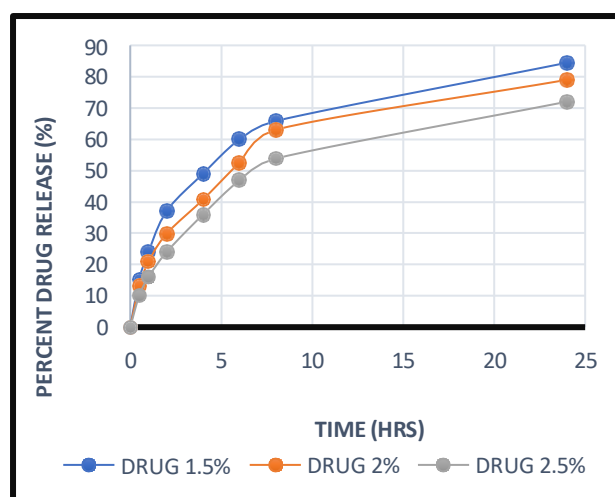


Figure 10: First Order Kinetics Graph

3.7 IN-VITRO DRUG RELEASE KINETICS

The release mechanism was checked applying different kinetic models, and the First Order model mentioned in **FIGURE 10** presented the highest R² value (0.9022),

therefore a concentration-dependent release with an exponential decrease with time. The Hixson-Crowell model (R² = 0.8614) mentioned in **FIGURE 11**

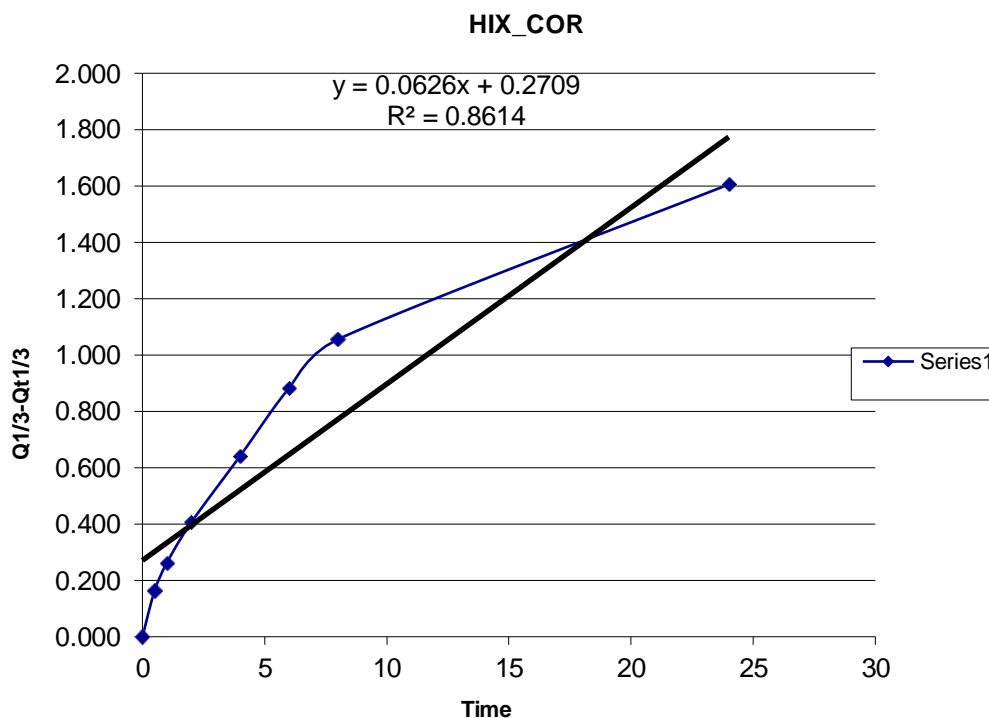


Figure 11: Hixson Crowell Graph

indicates dissolution-controlled release based on the combined effect of surface area of drug particles. The Zero Order model (R² = 0.769) has exhibited moderate fit indicating some contribution from the constant release mechanisms and Peppas model (R² = 0.5275) indicates the combination of process taking place. The poor performance of the Higuchi model (R² = 0.0659) suggests that the simple diffusion does not govern the process completely and it was mentioned **TABLE 2**.

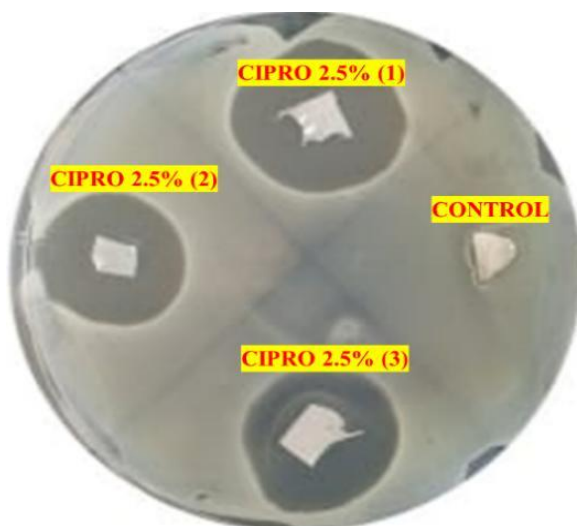
These results provide further evidence that the release of the antibiotic follows a first-order kinetics with much importance of the dissolution in order to optimize a controlled delivery of the drug. This formulation provides a lasting antibiotic release, vital for inhibiting infections for hernia correction. The findings of this investigation will contribute to the development of mesh parameters that promote beneficial controlled drug release, thereby increasing patient adherence and surgical outcomes while ensuring long-term antimicrobial activity.

RELE ASE KINET ICS	ZER O ORD ER	HIGU CHI MOD EL	PEPP AS PLO T	FIRS T ORD ER	HIXON CROW ELL
R ²	0.769	0.0659	0.527 5	0.902 2	0.8614

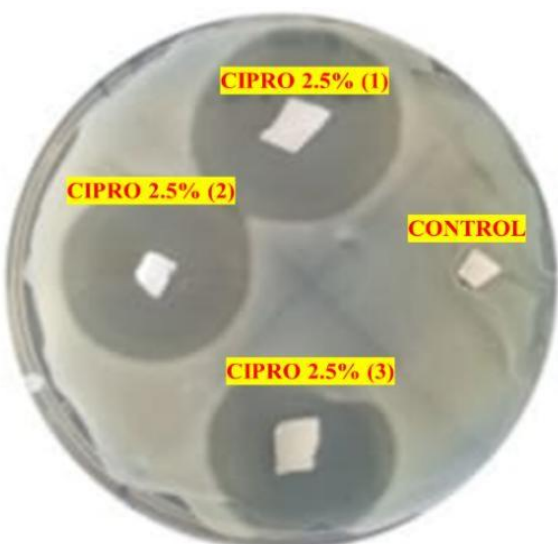
Table 2: R² Values of the Models

3.8 ANTI-MICROBIAL ACTIVITY

The antibacterial activity of hernia mesh soaked with the PVA, PVP, collagen peptide and ciprofloxacin compound were analyzed by zone of inhibition assay with *Staphylococcus aureus* and *Escherichia coli*. Average inhibiting zones of *S. aureus* and *E. coli* were 18.0 ± 5.0 and 26.0 ± 1.0 mm respectively as shown in **FIGURE 12**



A) *E. Coli* Iz Avg: 2.60 ± 0.10 Cm



B) *S. Aureus* Iz Avg: 1.80 ± 0.50 cm

Figure 12: Anti-Bacterial Activity A) *S. Aureus* Iz Avg: 1.80 ± 0.50 Cm B) *E. Coli* Iz Avg: 2.60 ± 0.10 Cm

which was indicative of bactericidal activity. The copolymer of PVA, PVP and collagen peptide matrix sustained the mechanical strength and controlled the release of ciprofloxacin for long-term antibacterial activity. Ciprofloxacin is a broad-spectrum antimicrobial that is effective against Gram-positive and Gram-negative bacteria, which is essential to prevent postoperative infection. The hydrophilic property of PVA and PV1 allows water to be absorbed, which facilitates drug diffusion into the target and leads to high local ciprofloxacin concentration. The substantial inhibition zones demonstrate the mesh's efficacy in preventing infections, particularly against Gram-negative *E. coli*, highlighting the mesh's potential in improving hernia repair outcomes by reducing infection risks.

4. CONCLUSION

The bio manufacture of a collagen peptide polymer mesh containing antibiotics is a major development in hernia repair. In our study, a new type of mesh was created that integrates throughout the composing process the advantages of both the structure and the bioactivity of collagen peptides, in addition to the mechanical benefits of synthetic polymers. Deposition of antibiotics in the mesh exhibited significant antimicrobial effect on the most frequent pathogens involved in POM infection, one of the most feared complications after hernia repair. The biocompatibility of collagen combined with the tensile strength and durability of Polymer has resulted in a mesh that offers firm support for tissue regrowth, but without the potential for long-term complications caused by permanent implants. The fabricated mesh displayed satisfactory physical and mechanical properties, such as feasible tensile strength, resilience, appropriate degradability rates etc. The *in-vitro* biocompatibility studies found that the meshes were able to allow cell growth and that they had reduced inflammatory response that fosters early ingrowth of tissue and healing. The resulting mesh may be biodegradable and of a resilient strength and biocompatibility properties and hence more suited for use in hernia repair. Further advances in fabrication methods, and finding other materials and techniques to couple with collagen, can further improve patient outcomes in hernia repair with the collagen-Polymer mesh. Therefore, the antibiotics-loaded collagen peptide-polymer mesh as a complex device for hernia repair had more favorable mechanical properties and antimicrobial efficacy. This novel approach could impact patient survival and reduce the complications associated with hernia repair surgeries.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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