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CONDUCTING POLYMER HYDROGEL FOR SMART DICLOFENAC-SODIUM DELIVERY: FORMULATION, CHARACTERIZATION, AND RELEASE KINETICS

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Conducting polymer hydrogels are 3D crosslinked networks of conductive polymers that absorb large amounts of fluid while maintaining sufficient conductivity, biocompatibility, and easy modification. Their conductivity is a result of conjugated double bonds, which enables controlled drug release triggered by specific stimuli, enhancing treatment precision across various disorders [1-2]. Diclofenac (DCF), a widely used non-steroidal anti-inflammatory drug, provides analgesic, antipyretic, and anti-inflammatory effects but is associated with risks like cardiovascular events and gastrointestinal ulcers [3]. This study formulates and characterizes a Polypyrrole (PPy)-sodium dodecyl sulphate (SDS)-agarose-polyvinyl alcohol (PVA) hydrogel for the sustained release of DCF, addressing its rapid clearance and side effect profile.

The hydrogel was synthesized via in situ polymerization, where PPy-SDS was formed and incorporated into a PVA-agarose matrix. PVA-agarose matrix was prepared by boiling until 90 °C internal. The formulation involved preparing an ammonium persulfate (APS)-initiated PPy-SDS gel, which was washed, blended with 5% PVA and agarose solutions, crosslinked with citric acid, and polymerized overnight. The resulting hydrogel was shaped into spherical molds, dried, and immersed in a diclofenac sodium solution for swelling and drug loading studies.

Analysis of the formulation was conducted, with UV-Vis spectrophotometry used to quantify DCF loading and release efficiencies. Swelling behavior increased from 76.5% after 2 hours to 175.4% after 5 days, while drug loading efficiency improved from 12.7% at 2 hours to 28.2% after 5 days, indicating sustained drug loading. Over a 2-hour period, only about 14% of the drug was released. The results indicate an initial gradual release phase, followed by a slower, sustained diffusion phase, reaching a plateau at approximately 90 minutes.

These initial findings demonstrate the hydrogel's potential for controlled drug release. Further kinetic modelling will help elucidate the underlying release mechanisms.

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