SMART GEL AND CONTACT LENSES-BASED DRUG DELIVERY SYSTEMS: NOVEL NANOTECHNOLOGY APPROACHES FOR TREATMENT OF COVID-19 ASSOCIATED CONJUNTIVITIS

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Background: The aim of the present work is to develop advanced ocular delivery system of Naphazoline hydrochloride in ophthalmic dosage forms including thermoresponsive hydrogel, contact lenses and ocuserts.

Methods: Naphazoline hydrochloride loaded niosomes coated with chitosan (N1) were prepared via thin film hydration method, in addition, thermoresponsive gel was synthesized by cold method using poloxamer 407: poloxamer 188 in 1:3, 1:1 and 3:1 mass ratio , (G1), (G2) and (G3), respectively. The prepared niosomes (N1) were incorporated in (G3). Ocuserts were prepared from alginate and calcium chloride solutions using ionic cross-linking containing Naphazoline hydrochloride loaded niosomes coated with chitosan (F1) . Moreover, alginate based contact lens containing free drug (F2), and also readymade contact lens soaked in drug solution (F3) were prepared. Gamma radiation was adopted for the sterilization for the different formulae prior their evaluation. Niosomes were evaluated for particle size, zeta potential, entrapment efficiency and morphology using zeta sizer and SEM. Thermoresponsive gels were evaluated for viscosity, PH and gelation temperature. Thickness, elasticity and transparency of ocuserts were also evaluated. In vitro release and kinetic analysis were studied for all formulae.

Results: The obtained results revealed that niosomes' particles size increased from a value 458 nm to 680 nm upon chitosan coating, polydispersity index (PDI) was 0.257 increased to a value of 0.656, negative zeta potential value of -38.3 mV was transformed to a positive 20 mV indicating successful coating. Entrapment efficiency of Naphazoline hydrochloride was 18% due to its hydrophilicity. The prepared hydrogels showed a pseudoplastic behavior due decline in viscosity upon increased shear stress from 6 rpm to 30 rpm, at which (G1) decreased from 200 to 60 cP, (G2) decreased from 200 to 80 cP and (G3) decreased from 500 to 120 cP, noting that maximum viscosity was exhibited by (G3) due to the higher proportion of poloxamer 407 relative to poloxamer 188. A pH value of 7.4 was detected in all prepared hydrogels, however, gelation temperature varied among them, (G3) showed the desired gelation temperature at 36.5 ± 0.5 °C, while (G1) did not gel at all upon increasing temperature and (G2) gelled at 29 ± 0.5 °C. Ocuserts (F1) and contact lens (F2) showed thickness of 0.3 mm and 0.25 mm respectively. They also showed elasticity due to absence of breakage upon 200 times of folding, however regarding the transparency, (F1) was opaque while (F2) was transparent. In vitro release studies and release kinetic models showed a satisfactory controlled release pattern of the drug from the aforementioned systems as the release of formulae N1, N2, N3 was 30.34%, 29.38%, 98.73% respectively, and the release of F1, F2, F3 was 28.68%, 18.28%, 0.05% respectively.

Conclusions: These diverse systems provide enhanced targeting drug delivery and offer a promising therapeutic strategy for future ophthalmological treatments.