



## Research article

**Surface modified nanostructured lipid carrier for improved ocular delivery: In vitro and ex-vivo**

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**ABSTRACT**

Nano structured lipid carrier (NLC) is a new generation Nano particulate system that offers several advantages over polymeric nanoemulsion. However, NLC possesses less muco-adhesiveness in the eye due to its anionic nature. Therefore, the present study aimed to modify the NLC with cationic compounds to improve corneal permeability. The objective of the present study was to prepare and optimize Dexamethasone surface modified NLC with carboxymethyl chitosan, and comparative evaluation of both with the marketed formulation. A conventional emulsification and ultrasonication method was used to prepare NLC. The optimized NLC formulations shown particle size ( $64 \pm 2.3$  nm), polydispersity index (0.270 $\pm$ 0.008), zeta potential ( $-12 \pm 3.42$  mV), and entrapment efficiency (96.66 $\pm$ 0.41%). Carboxymethyl chitosan loaded NLC showed particle size (260.73 $\pm$ 4.66 nm) and zeta potential (10.8 $\pm$ 6.0 mV). It exhibited sustained drug release over 24 h and marketed eye drop. In the ex vivo study, surface modified NLC had a permeability coefficient of 228.88 cm h<sup>-1</sup>, which is 2.60-fold greater than eye drop and NLC, respectively. Surface-modified NLC has shown comparatively sustained release with plain NLC and marketed eye drops. The surface-modified form can adhere firmly with mucin and shown improved trans corneal permeability. Therefore, CNLC is a potential nanocarrier for dexamethasone to minimize dose requirement and overcome systemic adverse events.

**KEYWORDS:** Cationic NLC, Ocular drug delivery, Ocular permeability, Dexamethasone

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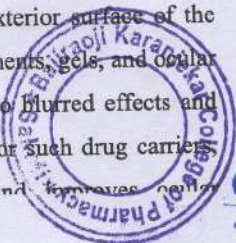
**INTRODUCTION**

Ocular drug delivery by topically instillation is still the most popular way of administration in treating several eye complications<sup>[1]</sup>. However, several barriers of the eye restrict the drug during its permeation through the cornea<sup>[2]</sup>. During topical delivery, drug loss occurs due to several factors such as eye blinking, tear turnover, and nasolacrimal drainage<sup>[3]</sup>. Moreover, nasolacrimal drainage may produce several systemic side events<sup>[4]</sup>.

Amongst the topical route, drug delivery with eye drop is popular. Nevertheless, eye drops remain for very short intervals on the eye surface after its application<sup>[5-7]</sup>. Therefore, they fail to achieve the desired therapeutics concentration at the exterior surface of the cornea. To overcome such limitations, eye ointments, gels, and ocular inserts have been tried. Indeed, they fail due to blurred effects and poor patient compliance<sup>[8, 9]</sup>. There is a need for such drug carriers which increases the precorneal residence and improves ocular

and nanostructured lipid carriers have shown promising ocular research<sup>[11]</sup>. However, NLC was found superior lipid nanoparticles with respect to entrapment efficiency, biocompatible, second-generation Nano carriers having impact on ocular permeability. However, NLC has a lesser muco-adhesiveness and can also be removed from surface due to less viscosity<sup>[13]</sup>. To overcome such an event surface was modified by incorporating carboxymethyl chitosan. These efforts can improve not only thickness but mucoadhesive property of the colloidal carriers.

Dexamethasone, an anti-inflammatory glucocorticoid, has been indicated in various ocular disorders such as inflammation, dry eye diseases and cataract<sup>[14, 15]</sup>. Dexamethasone has also been recommended to manage inflammation associated with post-cataract surgery. Dexamethasone available in eye



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