Contact lenses loaded with vitamin E and ionic surfactants for extended drug delivery

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Statement of the Problem: Ophthalmic diseases are most commonly treated with eye drops due to the low costs and self-administration. However, it has been reported that eye drops could deliver only about 5% of functional ingredients contained in a burst dosage since they suffer from tear drainage in addition to corneal and sclera barriers. To address the limitations of eye drops, researchers have explored the use of therapeutic contact lenses. Nevertheless, a major limitation of contact lenses in drug delivery is that most of the drug absorbed is released within the first few hours, fact that limits the use for extended release. The purpose of this study is to demonstrate the application of vitamin E diffusion barriers with ionic surfactants into contact lenses, in order to achieve controlled release of non-steroidal-anti-inflammatory drugs (NSAIDs).

Methodology: Silicone-hydrogel commercial contact lenses were soaked in ethanol solutions containing vitamin E and an ionic surfactant. Secondly, a NSAID was added to each lens by soaking the lenses in drug solutions for determined periods of time. The *in vitro* release experiments were carried by immersing the drug-containing contact lenses in phosphate buffer saline at physiological pH.

Results: Contact lenses containing vitamin E extend drug delivery up to a factor of 50, depending on the amount of vitamin E loaded and the physichochemical properties of the drugs. Vitamin E in contact lenses acts as a diffusion barrier that retards the diffusion of the drugs to the release medium. Contact lenses containing both vitamin E and a long-chain cationic surfactant further extend drug delivery due to electrostatic interactions between the anionic NSAIDs and the surfactant.

Conclusion: Contact lenses containing vitamin E and cationic surfactants can provide extended release of NSAIDs, and could be potential biomaterials to be used for the treatment of ophthalmic diseases. However, ocular irritation and toxicity studies would be needed to evaluate the safety of the approach.

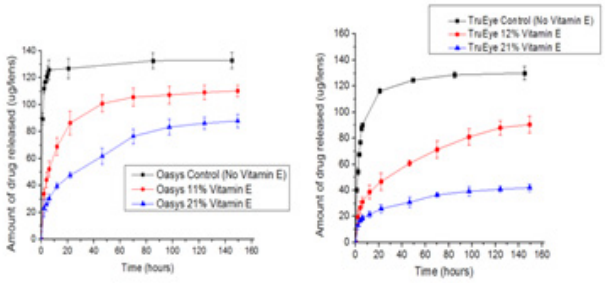

Figure 1. Amount of KTH released from the commercial contact lenses under two different vitamin E loadings. 1-A (left) Oasys® and 1-B (right) TruEye®. Data are presented as mean ± SD with n=3.

Recent Publications

1. M Gonidec, MM Hamedi, A Nemiroski, LM Rubio, C Torres. Fabrication of nonperiodic metasurfaces by microlens projection lithography. Nano letters (2016), 16 (7), 4125-4132
2. C Torres, N Hu, T Tammareddy, R Domcsy, J Yang, A Yang, NS Wang. Extended delivery of non-steroidal anti-inflammatory drugs through contact lenses loaded with vitamin E and cationic surfactants. Contact Lens and Anterior Eye (2019) (under final minor revision)
3. C Torres, N Hu, NS Wang, A Yang. Cationic microemulsion-based soft contact lenses for the controlled delivery of poorly water-soluble drugs. Abstracts of Papers of the American Chemical Society (2019).

Biography

Cesar Torres is a third-year PhD student at the University of Maryland, in College Park, MD, US. He has a dual bachelor's degree in Chemical Engineering and Chemistry, and a minor in Material Science & Engineering from the University of Idaho, in Moscow, ID, USA. As an undergraduate student, he participated in a summer research internship program at the Whitesides Group in Harvard University, working on nano-fabrication and soft-lithography. As a PhD student, he is focused on the application of nanotechnology to controlled release systems in contact lenses.

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