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DNA nanoparticles for ophthalmic drug delivery

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Abstract

Nucleic acids represent very appealing building blocks for the construction of nano-scaled objects with great potential applications in the field of drug delivery where multifunctional nanoparticles (NPs) play a pivotal role. One opportunity for DNA nanotechnology lies in the treatment of ophthalmic diseases as the efficacy of eye drops is impaired by the short survival time of the drug on the eye surface. As a consequence, topical administration of ocular therapeutics requires high drug doses and frequent administration, still rarely providing high bioavailability. To overcome these shortcomings we introduce a novel and general carrier system that is based on DNA nanotechnology. Non-toxic, lipid-modified DNA strands (12mers with 4 lipid modified thymines at the 5' end) form uniform NPs (micelles), which adhere to the corneal surface for extended periods of time. In a single self-assembly step they can be equipped with different drugs by hybridization with an aptamer. The long survival times of DNA NPs can be translated into improved efficacy. Their functionality was demonstrated in several ex-vivo experiments and in an in-vivo animal model. Finally, the NPs were confirmed to be applicable even for human tissue.

Keywords

DNA nanotechnology, drug delivery, ophthalmology, nucleic acids, nanoparticles