Novel Design and Evaluation of Chitosan Nanoparticle Ocular Drug Delivery System

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After working in an Indian Hospital, I realized that surgery for eye diseases is costly, unavailable, and inefficient, while the alternative is a drug in the form of eye drops. Current ocular drug delivery systems are insufficient due to the difficulty in penetrating protective layers of the eye such as the sclera, cornea, and conjunctiva while maintaining drug safety, efficacy, and bioavailability. Only about 1% or less of a topically administered drug can be effectively absorbed. Many of the current ocular diseases that affect 10% of all Americans and up to 50% of the elderly (cataracts, glaucoma, bacterial conjunctivitis) can be treated nonsurgically with simple eye drops of drugs if the ocular drug delivery system were improved. Instead of surgery, eye drops are easier, cheaper, not as labor intensive, widely available, and less time consuming. My research proposes a fluorescein labeled chitosan nanoparticle complex (CSFLNP) that can enhance the surface area of the drugs, permeability through the layers of the eye, control release of the drug, and target specific areas of the eye. Through spectrophotometric and electric field strength data, I found that several drugs for the major ocular diseases were able to be efficiently loaded all around the chitosan nanoparticles, released off over a 7-hour controlled time period, and had a 25% increase in permeability through a cornea simulated in vitro. The complex also enhances the surface area and adds around $3 to the original cost of the drugs while increasing the permeability, adhesiveness, and biodegradability, all ultimately contributing to the bioavailability of the drug. With this system, topical drugs can become a promising mass solution instead of costly/ unavailable surgeries.

Awards Won:

Second Award of $2,000