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Natural Deep Eutectic Systems: green and alternative drug delivery systems for ocular applications

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PURPOSE OF THE ABSTRACT

Ocular diseases are among the most common diseases and more than 2 billion people in the world suffer from any type of vision impairment or blindness due to ocular diseases. At least half of those have a preventable condition, with cataracts being the most prevalent, followed by glaucoma, diabetic retinopathy and age-related macular degeneration (ARMD).[1] The major causes for the development of ocular diseases are the natural process of aging and also the photooxidation caused by daily exposure to light.

The most common therapeutic strategies to treat ocular diseases include drops, ointments, injections and ultimately surgery. But the most convenient route and the most patient-compliant way to treat ocular diseases is through the administration of ocular drops. However, they present many challenges especially regarding the formulation of drugs, since many are insoluble and unstable in aqueous solutions and, therefore presenting low bioavailability.[2]

Recently, natural deep eutectic systems (NADES) have emerged as alternative systems for many applications. NADES are described as a mixture of two or more solid or liquid components, such as sugars, amino acids, organic acids or choline derivatives, which at a particular composition present a high melting point depression, compared to its individual constituents, becoming liquid at room temperature or near room temperature. NADES are highly biocompatible as they are composed by natural metabolites such as sugars, amino acids, and polyols; NADES are also biodegradable, task-specific, and their production is very cost-effective since there is no waste produced nor purification steps.[3-5]

NADES are known by their high ability to dissolve poorly water-soluble drugs and by their ability to stabilize biomolecules.[6,7] Moreover, in general, NADES present high viscosity that limits their use in several applications. Nevertheless, in the case of ocular applications their viscosity is actually a key feature because most ocular formulations have in their composition polymers, called viscosity enhancers, to increase the retention time of the drug in the surface of the eye. Therefore, the use of NADES as ocular drug delivery systems it would be possible to avoid the use of those polymers.

In this work we took the advantage of nature to develop greener and more sustainable ocular delivery systems, based on NADES. Rheological studies on NADES show that they are, in fact, able to be used as ocular drug delivery systems. Moreover, we show that the incorporation of natural antioxidants compounds with therapeutic action in ocular diseases is possible and that these compounds maintain their antioxidant properties over time.

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FIGURES

FIGURE 1

FIGURE 2

KEYWORDS

drug delivery systems | sustainable solvents | deep eutectic systems | ocular diseases

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