



## A review on ophthalmic delivery systems containing flavonoids for the treatment of eye diseases

Meltem CETIN<sup>1</sup> 

<sup>1</sup>Department of Pharmaceutical Technology, Faculty of Pharmacy, Atatürk University, 25240, Erzurum, Turkey

\*Corresponding author E-mail: [melcetin@atauni.edu.tr](mailto:melcetin@atauni.edu.tr)

### HIGHLIGHTS

- > Flavonoids have very beneficial effects on eye health, and also in the treatment of the eye diseases.
- > A decreased antioxidant capacity, oxidative stress and inflammatory mechanisms have a significant role in the development and progression of the ocular diseases.
- > Ophthalmic delivery systems can increase the ocular bioavailability of flavonoids.

### ARTICLE INFO

Received : 24 August 2021

Accepted : 22 September 2021

Published : 15 October 2021

### Keywords:

Eye disease

Flavonoids

Nano-sized formulations

Ophthalmic delivery systems

### ABSTRACT

Flavonoids, polyphenolic compounds, have many biological effects, including antioxidant, free-radical scavenging properties, antiviral, antibacterial, anti-inflammation, anti-allergic, and anti-carcinogenic effects, anti-platelet, anti-thrombotic, and vasodilating actions. A decreased antioxidant capacity, oxidative stress, and inflammatory mechanisms in the ocular tissues are considered to have a significant role in the development and progression of the ocular diseases. Flavonoids have very beneficial effects on eye health, and also the treatment of the eye diseases due to their antioxidant, anti-inflammatory and ocular blood flow enhancing properties. Most flavonoids have low bioavailability associated with low water solubility. It is important to develop effective ocular drug delivery systems containing flavonoids for application directly to the eye. This delivery systems can increase ocular bioavailability and enable flavonoids to reach the internal structures of the eye more effectively. Furthermore, considering the sensitive nature of flavonoids as antioxidant agents, especially nano-sized formulations have in particular become potential carriers for preserving them and improving their bioavailability and therapeutic efficacy. This review will focus the published studies that have investigated the development of delivery systems containing flavonoids for the treatment of eye diseases. In addition, within the scope of this review, flavonoids, common eye diseases, and the materials used in the preparation of the ophthalmic delivery systems containing flavonoids are briefly mentioned.

## 1. Introduction

Flavonoids are a big family of plant-derived polyphenolic compounds with diphenylpropane skeletons that are widely distributed in vegetables and fruits, thus, regularly consumed in the human diet. The number of different flavonoids identified until now is over 4000 [1]. Flavonoids, polyphenolic compounds, have several subgroups depending on the positions of the substitutes present on the parent molecule, which include flavonols, flavanones, flavones, isoflavones, flavanols or catechins, and chalcones [2,3]. These compounds have many

biological effects, including antioxidant and free-radical scavenging properties, anti-platelet, anti-thrombotic, and vasodilating actions, antiviral, antibacterial, anti-inflammation, anti-allergic, and anti-carcinogenic effects [1,3–5]. They are also capable of strengthening capillary walls and reducing fluid retention [6].

In a study, the *in vitro* antioxidant, anti-inflammatory, and antibacterial activities of the flavonoid fraction extracted from the leaves of *Abutilon theophrasti* Medic. (*A. theophrasti*), commonly used for the treatment of inflammation and joint pain in China, was evaluated. Their obtained results showed that the fraction has *in vitro* antibacterial, antioxidant, and anti-inflammatory effects and

Cite this article: Cetin, M. A review on ophthalmic delivery systems containing flavonoids for the treatment of eye diseases. *NanoEra* 2021, 1, 1–13.



Copyright © 2021 NanoEra.

This is an open access article distributed under the [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/), which permits unrestricted use, and sharing of this material in any medium, provided the original work is not modified or used for commercial purposes.