Optimization by response surface methodology of self-nanoemulsifying drug delivery systems (SNEDDS) as a new tool for the topical treatment of ocular diseases

Rosario Pignatello
Elide Zingale, Angela Bonaccorso, Teresa Musumeci, Claudia Carbone
Department of Drug and Health Sciences, University of Catania, Italy, and
NANOMED—Research Centre for Nanomedicine and Pharmaceutical Nanotechnology, University of Catania, Italy
r.pignatello@unict.it

The treatment of posterior eye diseases presents a significant challenge due to the difficulties in achieving effective delivery after topical administration. Topical administration is safe, characterized by high patient compliance, and does not require special medical interventions. Many active compounds are very effective in treating ocular degenerative diseases. like diabetic retinopathy (DR). However, the therapeutic efficacy of these molecules is limited by their poor bioavailability after topical administration. Self-emulsifying drug delivery systems (SNEDDS) represents an underexplored nanotechnology that offer significant advantages, including small particle size, stability, increased apparent solubility in water and bioavailability of the loaded compounds. These formulations are simple, consisting of only three components: oil, surfactant, and co-surfactant, mixed in the correct proportions. When the formulation meets an aqueous environment, such as tear fluid on the ocular surface, they spontaneously form in situ fine oil-in-water (o/w) nanoemulsion with a little globule size (less than 100 nm), due to specific conditions like physiological temperature, pH, and mild agitation due to blinking and without the need for high-energy processes.
The advantage of an anhydrous mixture is the enhanced stability of many molecules in the formulation over an extended period. Moreover, SNEDDS were shown to be cytocompatible with corneal and retinal cells.

The Design of Experiment (DoE) approach is an addition value element in the development of SNEDDS formulations. Pre-formulative and optimization phases are carried out using a computational approach.
Some examples will be provided among the studies carried out within the NANOMED Research Centre in Catania.