

# Supercritical Fluid Technology applied to Vision Science

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Supercritical fluid technology being a real alternative to the use of toxic organic solvents, it is of particular relevance to apply it to ophthalmic products or ocular medical devices since the eye is a fragile organ.

Cataract surgery is the most common surgery in the world with over 10 million every year. It consists of replacing the natural crystalline lens by an artificial one. One complication of cataract surgery is a postoperative endophthalmitis (POE), the incidence rate being of about 0.01-0.03 % depending on the nature of the antibiotic used at the end of the surgery and on its mode of administration<sup>1</sup>. One solution to reduce the POE incidence rate is to directly load the artificial intraocular lens (IOL) with the antibiotic.

The work presented here is focused on supercritical impregnation of IOLs with drugs. Commercial polymeric IOLs of different natures have been impregnated with two different antibiotics: ciprofloxacin and cefuroxime axetil. Experimental designs have been used to study the influence of the operating parameters upon optical properties of IOLs, drug loading and drug release kinetics. Different conditions of pressure (8 - 20 MPa), of impregnation duration (30 – 240 min), of pressurization and depressurization rates have been studied. The drug loading for ciprofloxacin varied from 0.8 to 4.12  $\mu\text{g}_{\text{drug}}/\text{mg}_{\text{IOL}}$  and the complete release of the drug has been observed after a period varying from 10 to 50 days<sup>2,3</sup>.

The last experiments in progress are dedicated to the impregnation of cefuroxime axetil.

It has been highlighted that the optical properties of the impregnated IOLs were preserved after impregnation. The dioptric power and the imaging quality based on the modulating transfer function have been measured before and after impregnation according to the International Organization for Standardization (ISO 11979-2:2014)<sup>4</sup>.

The next step will be focused on the study of the drug release in animal eyes and/or in human eyes performing *in vivo* tests.

<sup>1</sup>R.C. Bowen *et al.*, Comparative analysis of the safety and efficacy of intracameral cefuroxime, moxifloxacin and vancomycin at the end of cataract surgery: a meta-analysis, *British Journal of Ophthalmology*, In Press, 2018.

<sup>2</sup>A. Bouledjoudja *et al.*, Drug loading of foldable commercial intraocular lenses using supercritical impregnation, *International Journal of Pharmaceutics*, 500, 85-99, 2016.

<sup>3</sup>A. Bouledjoudja *et al.*, Effect of operational conditions on the supercritical carbon dioxide impregnation of anti-inflammatory and antibiotic drugs in rigid commercial contact lenses, *The Journal of Supercritical Fluids*, 130, 63-75, 2017.

<sup>4</sup>A. Bouledjoudja *et al.*, Supercritical impregnation and optical characterization of loaded foldable intraocular lenses using supercritical fluids, *Journal of Cataract and Refractive Surgery*, 43 (10), 1343-1349, 2017.