

XTribology
Excellence Centre of Tribology

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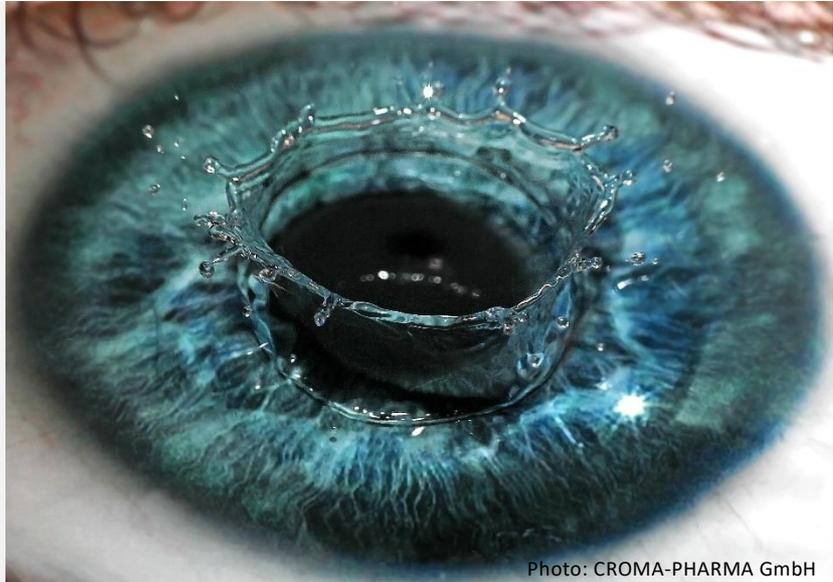


Photo: CROMA-PHARMA GmbH

TRIBOLOGY OF AN EYE

MEASUREMENT OF FRICTION BETWEEN THE EYELID AND THE OCULAR SURFACE AND EVALUATION OF THE EFFECTIVENESS OF INNOVATIVE EYE DROPS.

One of the most prevalent eye diseases is *keratoconjunctivitis sicca*, also called "dry eye" or sicca syndrome. With a prevalence of 5% to 35%, this condition can be regarded as a widespread disease. For various reasons, it leads to insufficient formation of a stable film of tears on the ocular surface, the surface of the eye. In particularly severe cases, the friction between the sensitive ocular surface and the eyelid increases severely. Small injuries and inflammations on the ocular surface cause pain, redness, itching and a particularly unpleasant sensation of presence of foreign bodies. In these severe cases, the usual symptomatic treatment in the form of tear substitutes is not expected to lead to a long-lasting therapeutic success.

The Lower Austrian company CROMA-PHARMA GmbH has developed the Lacrimera® eye drops based on its

innovative and patented chitosan-thiomer technology. These eye drops act as a stable, moisturizing protective film over the ocular surface for at least eight hours, thus ensuring an even hydration. The effectiveness of Lacrimera® has been successfully proven in clinical trials for mild and moderate levels of sicca syndrome.

The question now arises to what extent the product also shows long-term friction-reducing effects, so that successful treatment can be achieved even in severe cases.

SUCCESS STORY

A laboratory model to study friction between cornea and eyelid

Before administering eye drops to humans, the biophysical effect of eye drops is often assessed using animal tests (e.g. on rats). The laboratory model presented here, developed by AC²T and CROMA-PHARMA as part of a COMET cooperation project, can help to avoid the need for such animal testing. The aim of the project was to simulate the friction between eyelid and ocular surface in a laboratory model in order to compare Lacrimera[®] with other eye drops and two other test preparations.

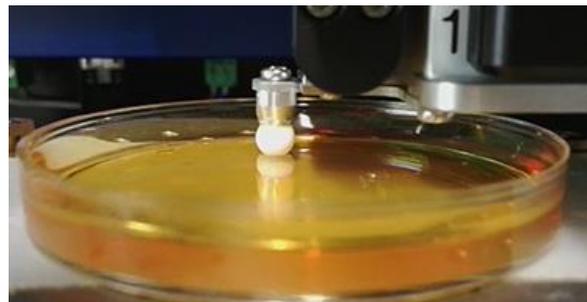
The technological challenge was to develop a model that was simple, robust and depicts the relevant chemical and tribological properties of the ocular surface. Specifically, the test specimen must: (1) in mechanical terms, be elastic and deformable like the eye; and (2) in biochemical terms, offer the chitosan-thiomer molecules binding possibilities like that of the ocular surface. CROMA-PHARMA has developed special test specimens with chemically modified gelatin and coated with mucin. These allow simple simulation of the friction conditions of the ocular surface. A further methodological challenge was that the forces acting on the eye or the eyelid are so weak that they can only be displayed and measured with very special friction measuring instruments (tribometers). With the help of a micro-tribometer

at AC²T, the friction-reducing effect of the test substances was simulated for 1000 eyelid strokes each. A coated, exceptionally smooth ceramic ball was moved 1000 times with an amplitude of 2 mm, a frequency of 2 Hz and a predefined contact pressure of 20 mN over the test specimens.

The measured friction coefficients come very close to the actual conditions in the eye, which indicates the reliability of the measurement results.

Impact and effects

Lacrimera[®] proved to be superior in tribological terms to the well-established eye drops and other test preparations. The laboratory model allows a realistic evaluation of the tribology of the eye. Thus, the development of eye drops can be accelerated and the number of tests on animals can be reduced.



Test setup for friction measurement of a simulated eye-lid contact (Photo: AC²T research GmbH)

Project coordination (Story)

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Project partner

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- AC²T research GmbH, Austria

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