A study by American researchers has revealed the fatty acid amide, oleamide, as a predominant lipid in meibum. Their findings could provide useful insights into the role of tear film lipid activity in corneal surface disease and suggest new targets for treatment, said Kelly Nichols, the study's lead author and assistant professor of optometry at Ohio State University, Columbus, Ohio, US.

The researchers used a technique called electrospray mass spectrometry to examine meibum samples of healthy volunteers. They identified several fatty acid amides in the lipid secretion, predominantly oleamide, but also myristamide, palmitamide, stearamide, and erucamide. Fatty acid amides had not previously been detected in the tear film lipid layer, Dr Nichols told Eurotimes, in an interview.

“Our findings are in line with previous research showing that there are many lipids within meibum. There are cholesterol, triglycerides, fatty acids and phospholipids, but the fatty acid amides had not been detected in that mix previously,” she said.

Dr Nichols noted that the tear film is like a water-mucus gel adjacent to the cells of the eye. On top of that there is a thin outer lipid or oil layer, which is secreted by the meibomian glands and is called meibum. However, it still remains to be elucidated how the various lipid molecules interact to maintain the ocular surface.

One of the most likely roles of the fatty acid amides in the lipid layer of the tear film is as a structural component involved in maintaining the stability, adherence and elasticity of the layer, Dr Nichols said.

“It may be that the fatty acid amides have some structural quality that keeps the lipid layer uniform. Every time you blink that lipid layer gets kind of squeezed together and then it has to spread out again without any breaks in it when you open your eyes, so they could play a role in giving some sort of memory to the tear film.

The tears need to have smooth surface because this is the refracting surface for vision and the lipid layer is also important in preventing tears from evaporating and in maintaining the comfort of the eye.”

Possible special role for oleamide

The finding of oleamide as a constituent of meibum is particularly interesting as previous research has shown that the molecule acts as neurotransmitter involved in sleep, as an agent in intracellular communication, and as a cannabinoid-like pain modulator. It is also widely used in industry as an anti-fogging agent or lubricant for making plastic films and for waterproofing in the paper and textile industry.

“I think it is likely that the amides are involved in maintaining the stability of the lipid layer. The tears need to have smooth surface because this is the refracting surface for vision and the lipid layer is also important in preventing tears from evaporating and in maintaining the comfort of the eye. But I’m intrigued by the secondary possibility of it working as some sort of neurotransmitter or in the communication between the ocular surface cells to maintain health.”

Dr Nichols pointed out that there is some evidence of a conversion pathway between fatty acids and fatty acid amides. She hypothesised that by converting back and forth, and thereby altering the ratio of fatty acids to fatty acid amides could act as a signalling mechanism to stimulate a healing response, or have some role in stabilising the tear film.

In dry eye disease, it could be the failure of such a signalling process that allows the degeneration of the ocular surface to occur. Moreover, if one component of the ocular surface is impaired it will have an impact on related structures. Therefore, an irregular lipid layer of the tear film lipid layer may contribute to the pathogenesis of diseases like blepharitis, meibomian gland disease and even allergies, or could play a secondary role in tear stability in these disease processes.

Mass spectrometry more sensitive

Fatty acid amides had not been detected in meibum before. The techniques used in previous research were not enough to identify specific individual lipid molecules.

“When you use techniques like thin layer chromatography you’re comparing to a known standard and identify it on the basis of retention time, in some cases visually. But within a given band there can be many different molecules. With mass spectrometry you will see that there are many things within that band,” Dr Nichols said.

Developed in the late Eighties and early Nineties, new mass spectrometry techniques involved spraying a prepared sample through a capillary tube and through an electrical source that ionises the small particles, which then travel down a tube to a detector. The individual molecules can then be distinguished based on how fast they travel down the tube. With two spectrometers set up back-to-back, the technique fractures the molecules and the way that they break apart in the mass spectrometer provides an indication of their molecular structure.

Dr Nichols added that she and her associates are currently investigating the role of fatty acid amides in the role that the lipid may play in dry eye.

The findings of their mass spectrometry study appeared in the January 2007 issue of Investigative Ophthalmology and Visual Science.

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Study sheds new light on tear film composition