Study of Human Lenses by FTIR Spectroscopy

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The point of our study was to analyze human lenses with cataract and find out the changes depending of illness level. Cataract illness manifests by a decrease in visual acuity, which, apart of health problems, gives rise to social and economic consequences. There are many causes of this illness, and each of them differently affects the chemical structure and phase composition of the lens. This disease requires surgical intervention, to remove the cloudy lens and to introduce the eye lens polymer [1]. Today, ophthalmology commonly uses phacoemulsification method, during which the lens is broken up by ultrasound and its fragmented parts are removed from eye.

In this work experimental material was obtained from the lenses removed during surgical intervention from patients aged 65-90, with different visual acuity and glucose level. The duration of ultrasound, applied during phacoemulsification surgery, was from 3.6 to 16.7 seconds. The small fragmented lenses were analyzed by FTIR method using Excalibur spectrometer, equipped with globar source, DTGS detector, and ATR attachment with ZnSe crystal. The data were collected in transmission mode and internal reflection mode in the region from 600 cm^{-1} to 4000 cm^{-1}. The spectral resolution was set to 4 cm^{-1}. Spectra were normalized and converted into second derivatives.

In our study it was important to analyze the relations between bands in the region of 1000 cm^{-1} to 1900 cm^{-1}. Such a requirement had been proved by Shan-Yang Lin et al. [2] who analyzed lenses by FTIR method. They suggest that the β-sheet structure was a predominant component in Amid I. Additionally, the peak intensity ratio of Amid I to Amid II decreases for cataract lenses and for glaucomatous lenses. Our results indicate that the ratio of Amid I /Amid II is about 1.25 and has tendency to decrease with glaucoma level. The similar trend can be observed when we compare this ratio with high level of cataract process, correlated with longer ultrasound duration in course of operation.

Most of ocular human diseases are associated with Zinc deficiency [3]. Several proteins are directly associated with Zinc transport. To study this issue, in our work the elemental composition of samples was determined by means of micro-Proton-Induced X-ray Emission (μPIXE) method. The results indicate that the level of Zinc concentration decreases with visual acuity as well as with high level of cataract process.

References:

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