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POLARIZATION PROPERTIES OF THE TISSUES OF SOME ENDOCRINE GLANDS OF INTACT RATS

Abstract. *The polarization properties of the tissues of some endocrine glands of the thyroid and suprarenal glands tissue based on histological section were studied in the paper. The investigation by means of laser polarimetry method of the thyroid and suprarenal tissue demonstrated the polarization properties of the glands of intact rats in health.*
Key words: *thyroid gland, suprarenal gland, laser polarimetry.*

Introduction. For the last decade topicality of the use of laser polarimetry methods has grown to determine properties of biological tissues as exactly they allow to find out the spatially updiffused properties of an object, define the presence of dissipation areas distribution and get local high-frequency information. Interesting are possibilities of the use of laser polarimetry methods to determine the properties of glandular tissue, namely tissues of the thyroid and suprarenal glands. In the process of development of diagnostic methods, it was found that the peculiarity of biological tissue structure is a double-base amorphously crystalline structure [1]. The use of lasers in biomedical optics stipulated the development of a number of researches – laser polarimetry of the biological tissues, which is based on the statistical analysis of polarizing-inhomogeneous objective fields [3, 7]. Radiation field dispersed by biological tissue, becomes the carrier of information about their properties. This information is found to be contained in photometric, spectral, polarization and correlation characteristics of light vibrations [5]. However, the questions of the use of laser polarimetry methods remain little studied to examine the properties of glandular tissue, such as the thyroid and suprarenal glands which is topical for differential diagnostics of their pathological processes [6].

Objective: to study polarizing properties of optically thin cuts of the thyroid and suprarenal glands tissues of intact rats.

Materials and methods. Researches are conducted on 20 white mature rats-males with initial body weight 100-150 grammes. To study polarization properties of the thyroid and suprarenal glands they were removed and fixed in 10% neutral formalin solution with the triple change of a fixator, dehydrated in the alcohols of growing concentration, whereupon sealed in paraffin blocks. Microsections 5-6 mkm thick were made and studied under BIOLAMAS P-12, a light microscope. To estimate diagnostic possibilities of statistical analysis of the tissue images of the glands non-stained microsections (20 preparations) were examined from physiological normal glands of the intact rats. Polarization images of the thyroid and adrenal tissues were received by microobjective lens, projected in the plane of photosensitive ground (800x600 pixel) of CCD- camera, which provided the range of measuring structural elements of the biological tissues for such sizes: 2 mkm – 2000 mkm. Examination of polarization images of gland tissues are presented by an optical chart (fig. 1). Illumination was conducted by the parallel ($\varnothing = 10^4$мкm) bunch of He-Ne laser ($\lambda = 0.6328$ мкm, W = 5.0 мВт). Polarization illuminator consists of quater wave plates 3; 5 and polarizer 4, that provides forming of laser bunch with an arbitrary azimuth $0^0 \leq \alpha_0 \leq 180^0$ or ellipticity $0^0 \leq \beta_0 \leq 90^0$ of polarization.
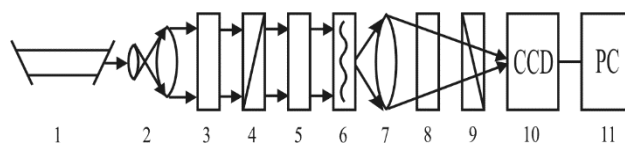

Fig. 1. Optical chart of polarization images examination of microsections of the thyroid and suprarenal gland tissues

Results and discussion. Polarization images are presented on (fig. 2) optically thin microsections of the thyroid glands in the norm (coefficient of weakening, $\tau \leq 0,1$ geometrical

thickness 40 μm) for axial (0 – 0) and crossed (0 – 90) polarizer 4 and analyzer 9. As a basic analytical instrument to evaluate aggregation of casual values characterizing the image of a biological object (intensities) and its optical geometrical structure (directions of orientations of protein fibrils ρ and index of double refraction of their matter Δn), the statistical moments of the first M, second σ, third A and fourth E orders of their values were used, which calculated by finding an average on every pixel of recording CCD – camera.

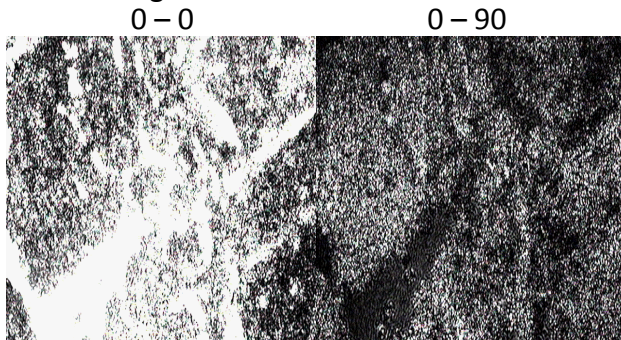0 – 0   0 – 90

Fig. 2. Polarization images of optically thin cuts of the thyroid gland, got for axial (0 – 0) and crossed (0 – 90) polarizer and analyzer

The findings obtained demonstrate the tendency of growth of statistical moments values of distributing orientations of the thyroid gland tissue. The statistical moments of the third (A_ρ) and fourth (E_ρ) order grow most quickly (table.1). Polarization images are presented on (fig. 3, 4, 5, 6) optically thin microsections of the cortical and medullar tissues of the adrenal

Table 1
Statistical moments of 1 – 4 th orders of the coordinate distribution of intensity of the thyroid gland images

I	$I(0-0)$	$I(0-90)$
M	0,9 $\pm$ 5%	0,6 $\pm$ 4%
σ	0,23 $\pm$ 4%	0,29 $\pm$ 6%
A	38,6 $\pm$ 7%	26,8 $\pm$ 11%
E	74,2 $\pm$ 9%	132,8 $\pm$ 14%

gland in the norm (coefficient of weakening, geometrical thickness 40 μm) got for axial (0 – 0) and crossed (0 – 90) polarizer 4 and analyzer 9.
An image of optically-thin (a coefficient of weakening, is a geometrical thickness 40) microsections of fabric is the prostates got for співвісних (0 – 0) and crossed (0 – 90) поляризатора 4 and analyzer 9 presented on rice. 7.
The findings obtained demonstrate the

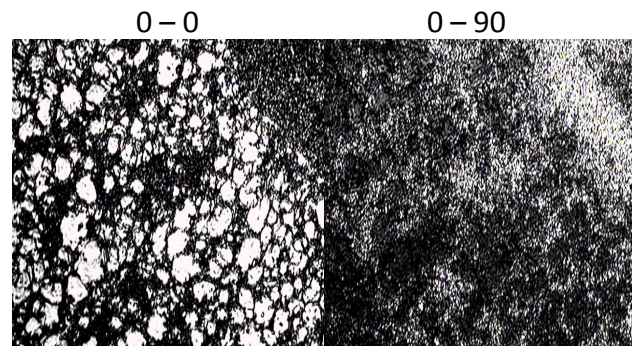0 – 0   0 – 90

Fig. 3. Polarization images of optically thin cuts of the glomerular zone tissue of the adrenal gland, got for axial (0 – 0) and crossed (0 – 90) polarizer and analyzer

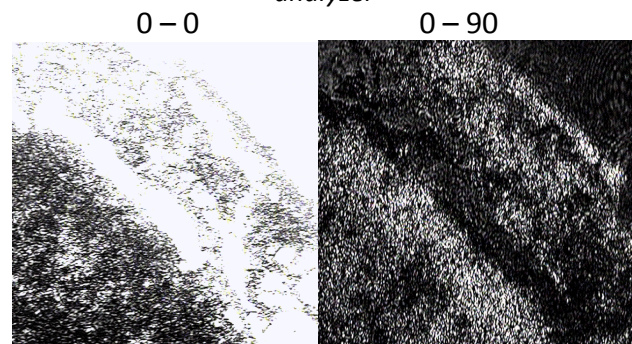0 – 0   0 – 90

Fig. 4. Polarization images of optically thin cuts tissues of the fasciculate zone of the adrenal cortex, got for axial (0 – 0) and crossed (0 – 90) polarizer and analyzer

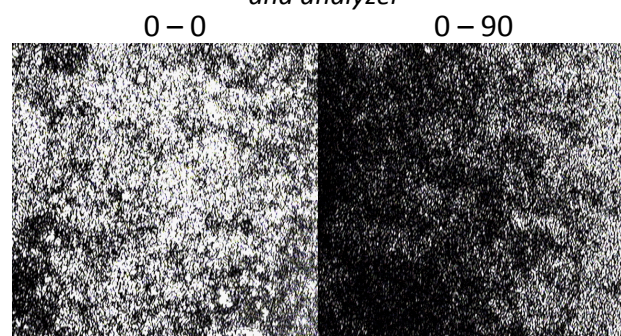0 – 0   0 – 90

Fig. 5. Polarization images of optically thin cuts tissues of the reticular zone of the adrenal cortex, got for axial (0 – 0) and crossed (0 – 90) polarizer and analyzer
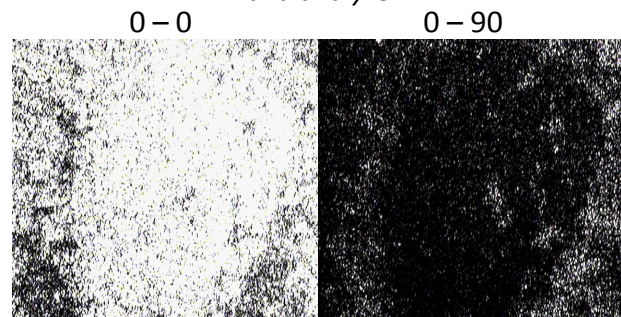
0 – 0   0 – 90

Fig. 6. Polarization images of optically thin cuts of the adrenal medulla, got for axial (0 – 0) and crossed (0 – 90) polarizer and analyzer

tendency of growth of statistical moments values of distributing orientations of the prostate gland tissue. The statistical moments of
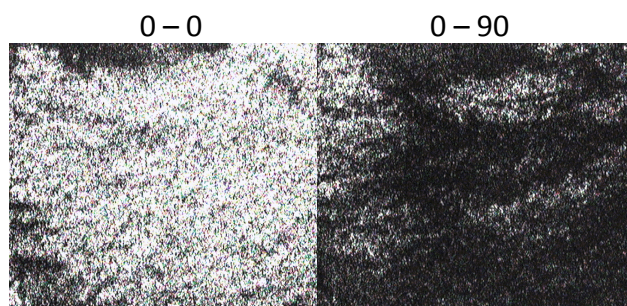
0 – 0   0 – 90

Fig. 7. Polarization images of optically-thin layers of fabric are the prostates got for axial (0 – 0) and crossed (0 – 90) polarizer and analyzer

the third (A_ρ) and fourth (E_ρ) order grow most quickly (table.2).

Table 2
Statistical moments of 1-4 orders of co-ordinate distributions of intensity of images of fabric of prostate gland

l	$I\,(0 - 0)$	$I\,(0 - 90)$
M	$0,9 \pm 5\%$	$0,6 \pm 4\%$
σ	$0,23 \pm 4\%$	$0,29 \pm 6\%$
A	$38,6 \pm 7\%$	$26,8 \pm 11\%$
E	$74,2 \pm 9\%$	$132,8 \pm 14\%$

Statistical approach in the analysis of polarization images was found to detect considerable diagnostic sensitiveness of the moments of higher distribution orders of image intensity of optically thin microsections of the thyroid and suprarenal glands [4]. Consequently, the results obtained correlate with previous information of statistical researches of polarization properties of other biological tissues (derma of skin, muscular tissue) [2,5].

Conclusion. Performed polarization researches for intact animals allowed to set the parameters of the norm of polarization properties of the thyroid and suprarenal glands tissues in rats.

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