effect of some physical stimali on the bioelectrical properties and molecalar structure of theeye

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The present work is aimed to study the effect of argonlaser, of the same intensity and duration as that used duringretinal treatment, on the structure and function of thechicken eye by the use of some biophysical techniques. Itconsists of four chapters.Chapter I contains the introduction and review of1iteratures for essential and recent work in the field ofretinal electrical activity, molecular structure andhistology in addition to the different laser duration effectson the whole eye.Chapter II includes the theoretical aspects of the usedphysical techniques while the material and experimentaltechniques are illustrated in chapterChapter IV demonstrates the obtained results accompaniedby comments and discussion. It is divided into' four mainparts:1- Electroretinographic records (ERG),2- Dielectric parameters of the chicken eye,3- Infrared (IR) spectroscopic measurements and4- Retinal histological study.The following results were obtained :1- The ERG, records (especially its b-wave) were found to beaffected by the chicken age, state of adaptation andtemperature change. The b-wave of the ERG has reachedapproximately a constan~ value at 2-3 weeks. Accordingly,the age, in this work, was fixed at this range. It wasmore sensitive to temperature variations than the a-waveand this sensitivity was altered during light (photopic)and dark (scotopic) adaptation.The photopic curve ofrelationship behaved inscotopic curve and thisthe b-wave amplitude-temperaturequite opposite manner than theis because most of the retinalcells behave with opposite manners in case of light anddark adaptation. so, it is of great important to take thestate of adaptation and the temperature at a suitablevalue, into consideration during the retinal treatment.Chicken eyes exposed to a laser beam of intensity 1 mW/cm2and durations 0.12 & 0.25 sec at a temperature range of10-30 'C showed pronounced variations in their ERG recordsbefore, immediately and after 1-5 days of laser exposure.These variations depend on the eye temperature, state ofadaptation as well as on the laser dose (intensity Xduration) .In case of laser exposed light adapted eyes, the amplitudeof the b-wave (Ab) of the ERG showed a fluctuateddecrease, from their normal values, in the first threerecovery days' and then they approached the completerecovery in the fourth and fifth recovery day· for laserdurations of 0.12 & 0.25 sec respectively. This recoverywas more significant when the eye temperature wasmaintained at 10 ·C.In case of laser exposed dark adapted eyes, similarvariations of Ab with temperature were found but they weremore regular than those of the light adapted

ones.2- The dielectric measurements showed an accurate method forstudying the structural and functional states of the eye.The impedance components (real ZR and imaginary Zr)’ thedielectric losses EOl and the relaxation time 1 were foundto change with temperature and after laser exposure.A set of semicircles, demonstrating the relation betweenZR & ZI’ of dark adapted chicken eyes, before and afterlaser exposure at a fixed temperatures of 10, 20 and 30’C, indicated pronounced variations of ZR and ZI’ withrespect to temperature in the frequency range of 0.5 - 50KHZ. Their values changed at the first recovery days andthen approached the normal value in the fourth or fifthrecovery day.The relation between dielectric loss E”and the logarithmicvalues of the’ frequency log f for dark and light adaptedchicken eyes,before,immediately and at the fourth recoveryday at temperature 10, 20 & 30 •C, indicated a maximumvalue of dielectric loss E”max at the frequency range of900-2000 HZ.This value of e”max was found to increase in the immediateexposure and then decreased, approaching to normal value,in the fourth recovery day especially, at lO’C so that wemay expect that this temperature is more suitable indecreasing the laser damage and hence decreasing the timefor complete recovery.On comparing the results of the laser effects on the eye,in both cases of adaptation, we found that the variationsof e” max in the five recovery days, and so, the repairingprocesses, in case of dark adaptation, were more regularand pronounced than those in case of light adaptation.The relation between the natural logarithm of thedielectric relaxation time (Ln r) and the reciprocal oftemperature (liT)’ for both cases of adaptation,represented two approximate parallel lines which have aslope provided the entholpy fJ. H and two interceptionsindicated two values for the entropy fJ. S. The obtainedvalues of b S, which describe the local disorder,indicated that l> S is more pronounced in case of lightadaptation than that in dark adaptation. This confirmedthe idea that the processes of recovery are morepronounced in case of dark adaptation in addition to thatthe temperature of the eye must be maintained at 10 ·C.This is in good agreement with our previous finding incase of ERG records and the dielectric methods results.3- The obtained IR spectra of the total retina confirmed theobtained results by the polarized IR studies of visualpurple membrane which conclude that the rhodopsin has ana- helix structure with special orientation with membranenormal.Retinaii exposed to a laser beam of constant intensity(lmW/cm2) and different durations (0.12 & 0.25 sec) atfixed temperatures (10, 20 & 30 ’C) showed no detectablefrequency change, indicating that there is no change inthe main helical structure of membrane protein. Thechanges were in the orientation angle of rhodopsin asindicated from the ratio of amide II (1540 cm-1) and amideI (1662 cm-1).The sensitivity of chicken retina for the recovery of thereorientation of rhodopsin was more pronounced after laserexposure of duration 0.12 sec than that of 0.25 sec, andthe decreasing in the chicken eye temperature (10’C) whichcompensate the heating effect due to the increase in laserduration.4- The histological structure of the chicken retina, beforeand after laser exposure was studied by using light andelectron microscopes.The light microscopic studies, of the exposed retinaindicated pronounced changes in the pigment epithelium andthe photoreceptor layers and these changes, in case oflaser duration 0.25 sec, were more clear than those incase of 0.12 sec.The electron microscope studies were

concentrated on thenormal and exposed pigment epithelium and photoreceptorslayers to investigate more of their structural details.The results of the present work, obtained due to theapplication of the different biophysical techniques werevery useful in constructing a simplified schematic modelsummarized the possible mechanism of laser damage jrepairprocesses and suggesting the best suitable conditions forlaser retinal treatment.