

THE INTEGRATED INDICATOR OF RADIATION ON THE BASIS OF MOLECULAR SYSTEM OF LIOTROPIC LIQUID CRYSTAL

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Abstract

One of outcomes of ionizing radiation influence on biological molecular systems is the formation of fissile oxygen shapes in human blood plasma, which, in its turn, initiates free radical oxidation of lipids. In present investigations, the connection of fissile oxygen shapes appearance with physicochemical parameters of human blood plasma and heart attack is established. An attempt was made to offer the new integrated radiation indicator for radiology examinations and monitoring.

Key words: *textural characteristics, polarization microscope, dendrites, blood plasma, genetic, radiology*

BACKGROUND

The systematic investigations of donors blood plasma (20 tests) and blood plasma exposed to the ionizing radiation influence (the radiant with stationary values of radionuclide cesium - 137, activity $0.5 \cdot 10^{-2}$ mGr/day and obtained radiation dose 1,7 mGr/day) were carried out. In present examinations, the device «Gammacell-220 (England)» was utilized. The exposure was carried out by gamma-quantum's Co - 60 at the potency of radiation dose 10 Gr/minute.

Textural characteristics (1) were received in the flat capillaries of the "sandwich" type (2) and revealed on the polarization microscope MIN-8. The flat capillary had the square $\sim 1 \text{ sm}^2$ and thickness $\sim 10 \text{ }\mu\text{m}$. A thin polymer film with the surface tension coefficient (2) that had regulating polar and dispersion constituents covered the inner surface of the flat capillary in the «glow» discharge reactor. The values of polar and dispersion constituents were defined by the solution of the system of equations on personal computer. The optical parameters of the blood plasma were registered in the range $500\text{-}4000 \text{ sm}^{-1}$ (on device Specord-80M) and $10\text{-}600 \text{ sm}$ (on Fourier spectrometer with computing complex). The free radical oxidation of the lipids was carried out in vitro in the aerosol regime by passing through them ozone-oxygen mixture, which was obtained in a barrier discharge reactor (1,5 % ozone, α - radiation activity $20 - 350 \text{ Bq/m}^{-3}$). The phase transition temperature was

defined in the model cellular-vesicular structure (gel- liquid crystal state) from the dependence on conductivity within coordinates (logarithm of electrical conductivity of blood plasma - $1/T$ [Kelvin⁻¹]). The results of the model experiments *in vitro* were compared with the effects of the medicinal antioxidants *in vivo*.

It was stated, that when the current in the reactor of «glow» discharge is $0\div 10^{-2}$ A, the processing time of capillary is $0\div 5400$ sec, the flow speed of the mixture gentle gas-monomer (methacryl acid and others) is $V = (2, 5\div 5, 0)\times 10^{-3}$ H/m, under $\gamma_s^d: \gamma_s^p = 1\div 10$. Removing the water from the flat capillary, the dendrites, spherolytes, «fan»- and needle-shaped crystals in the solid phase in the blood plasma of patients with myocardial infarction and the lines of liquid crystals in donors blood plasma were registered. It was indicated, that the maximal speed of crystallization (up to $0.2 \mu\text{m}/\text{sec}$) was on the layers with state $\gamma_s^d: \gamma_s^p = 10$. The layers of this quality at the first time helped to receive the pseudo isotropic textures of the cellular type (with size up to $10 \mu\text{m}$) in the lamellar phase in the flat capillary. The textures of the regular pentagonal and hexagonal shapes with 90° polarization plane of the membranes wall rotation present especial interest. In our opinion, it is connected with rotational isomerisation (rot[+] and conformation rot[-]) as well, as with the weak interaction of non-polar biomolecular groups and their location in the dodecahedral regions in the combination with the cavities of 14-hedrons, forming clathro - similar solution. The textural research complies with the results of the biochemical and spectral analysis. The Fourier-spectroscopy helped to specify the stratification of the biocolloid and the breaking hydrogen connections during dismetabolism. The metabolic disorder, in the case of myocardial infarction, the simulation of peroxide oxidation of the lipids by the ozone treatment of the blood plasma *in vitro* and the action of the antioxidants *in vivo* were fixed in the infrared spectrum by changing the line intensifies of non-saturated connections of the arachidonic and linolenic acids $-\text{C}=\text{C}-\text{C}=\text{C}-$ ($\lambda \approx 1680\div 1580; 1070 \text{ cm}^{-1}$) and catabolism products groups $=\text{COC}=\text{C}=\text{C}-$ ($\lambda \approx 3050\div 2990 \text{ cm}^{-1}$), $-\text{C}\equiv\text{C}-$ ($\lambda \approx 2140 \text{ cm}^{-1}$).

The analysis of the lines $-\text{P}-\text{O}-\text{C}_6\text{H}_5$ ($\lambda \approx 1240\div 1990 \text{ cm}^{-1}$) and $-\text{P}-\text{O}-\text{R}$ ($\lambda \approx 1960\div 1940 \text{ cm}^{-1}$) is promising. The changing of the spectra intensity and breaking the regular textures during ozone treatment with the rising of total area of the optically active groups, allow to make a conclusion, that the ability of a blood plasma to the lyomesomorphism and structuring indicates the infringement of recycling of the membrane material, of metabolism and operation of ionizing radiation.

The examinations of malonic dial content in blood plasma were carried out using the conventional and photometry method. The basis of the method is the response of an acid with such yields of responses lays, as composite peroxidings, which at heating up in a sour medium are decomposed, forming malonic dial. At interaction of one molecule MDA with two molecules acid the pink complex is formed. Measuring of optical density carried out (spent) at lengths of waves 535 and 590_{HM} concerning monitoring. A content MDA defined (determined) under the formula at 535 and 590_{HM} .

Observed dates of concentration of malonic dial in plasma of blood through 24 and 48 clocks after acute action of a gamma-ray in a dose 1 Gy are submitted $30 - 50 \mu\text{M}/\text{L}$ ($p < 0.01$).

As well as the concentration MDA in whey of blood was necessary to expect after action of a gamma-ray is incremented and in 48 clocks after an exposure reliably exceeds a master level in $1,5$ times. Characteristically, that for 2 day after an exposure the concentration MDA is higher, than per 1 day. Such dynamic of magnification of concentration MDA coincides with development of acute radial illness of a light degree of gravity. This fact testifies that the modification of concentration MDA well reflects gravity and course of processes of a radiation injury of a biological system.

Dates of concentration of malonic dial in plasma of the blood which has exposed within 210 day to action low of an intensive gamma-ray with a potency of a dose 61 sGy /

year are submitted has made $\mu\text{M/L}$ ($p < 0.01$). The aggregate absorbed dose obtained animal has made 36 sGy.

At comparison of outcomes obtained at an acute and chronic exposure of mice it is visible, that the concentration MDA in plasma of blood animal, exposed to a chronic exposure in a dose 36 sGy, is higher than at mice exposed to acute action in a dose 1 sGy, that allows to assume, that a chronic exposure on the effect similarly to violations of exchange processes, in particular, as shown in operations of a series(line) of the authors, at violation of exchange processes at a heart attack.

Examples of the needle-shaped crystals from patients who have undergone acute myocardial infarction are shown in figure 1. The application of traditional methods of medical treatment led to the crystals observed during the treatment passing through the stages of small spherulites, big spherulites, then fan-shaped crystals. Patients who had undergone a successful course of treatment and returned to a normal life style showed the fan-shaped crystals depicted in figure 1.

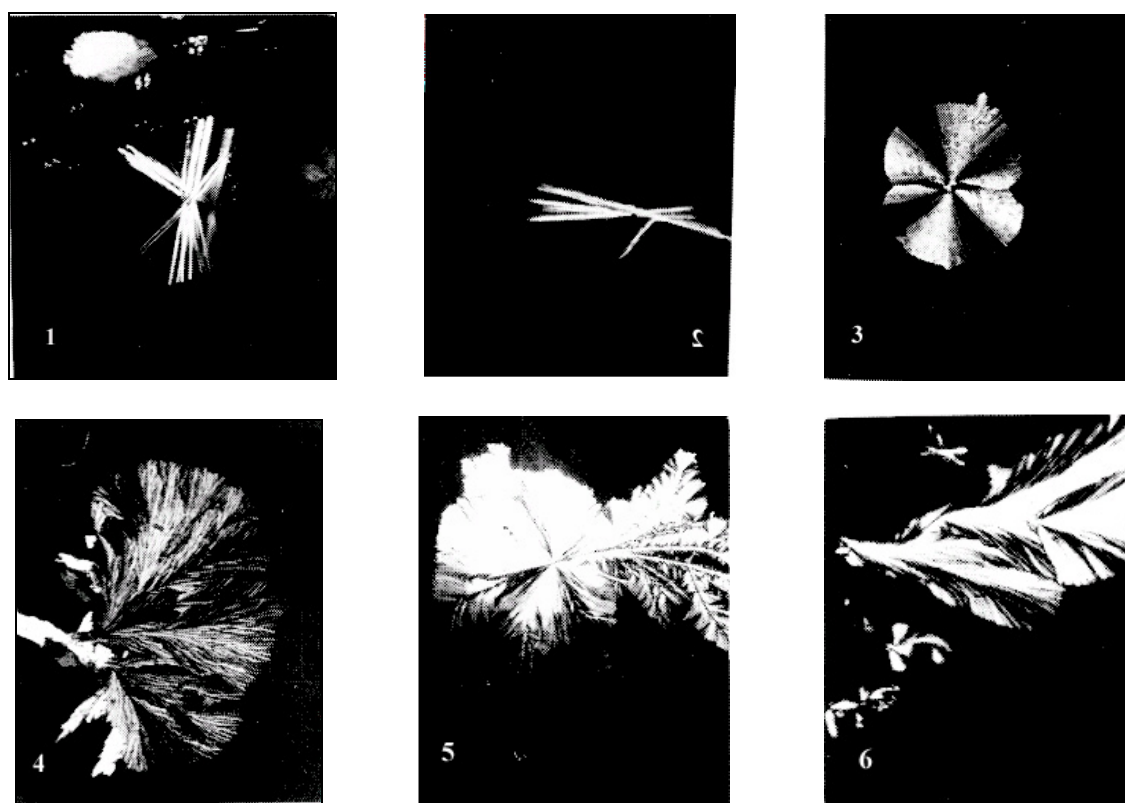


Figure 1 Textures of molecular crystal phase in human blood plasma: 1, 2 - needle shaped; 3 - spherulite; 4, 5 -dendrites; (1-5 patients with myocardial infarction); 6 - fan - a crystal of the healthy person

The pseudo-isotropic textures with oil lines, typical for lyotropic liquid crystals, were found in human blood plasma in the sandwich type cells decried in⁵ with plasma-chemical coverings as the soapy kernel lamellar phase. Here amphiphilic molecules in the water arrange as bilayers. The degree of regulation of these structures by the oil lines may be defined analogously to cholesterol liquid crystals, with the isotropic structures arrangement and coagulation layers within the liposome's formation having different degrees of orientations. Investigations using the lamellar phase showed that it could be used to obtain information about the state of the patient's health: A lamellar phase with unclosed textures is typically observed from healthy donor plasma (figure 2). Those from patients with

myocardial infarction differed, are typically pentagonal or hexagonal. Examples of such textures are shown in figure 2. We can clearly observe the surface polarization rotation of $\sim 120^\circ$ in the lamellar phase. Similar data is obtained from the textures of healthy young females (2nd and 3rd year students) following ozone treatment of samples of their plasma. All of this allows us to model the dismetabolism *in vitro*, or to observe the formation process of the breaches *in vivo*.

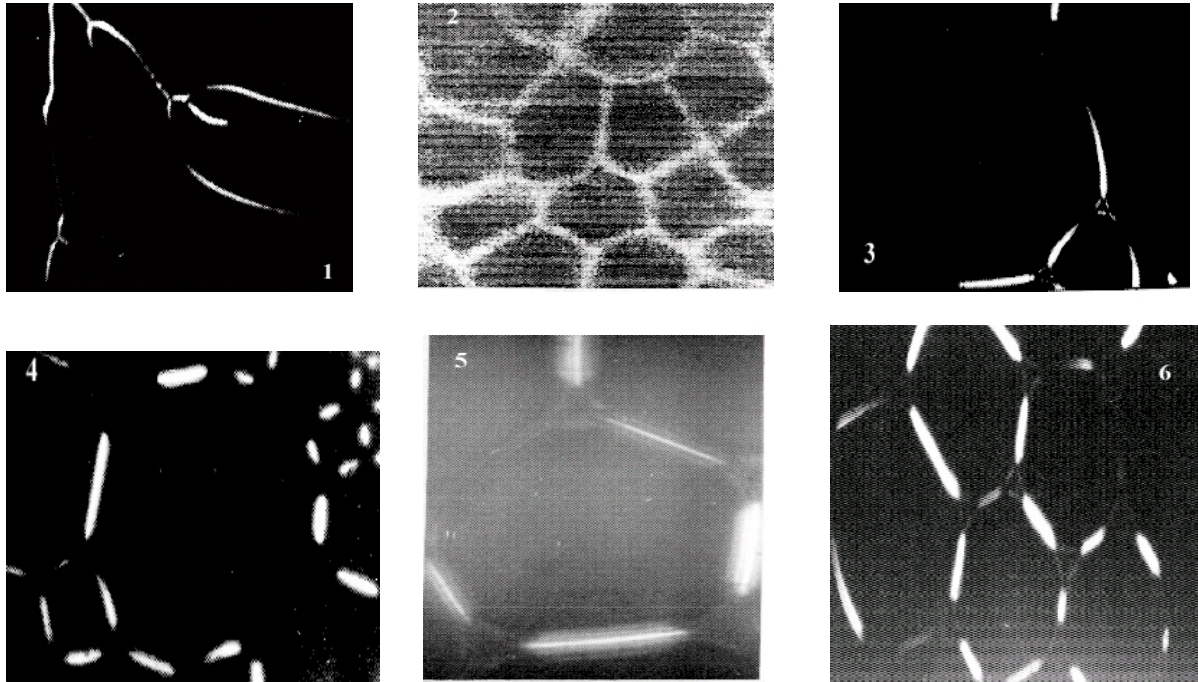


Figure 2 Textures of lamellar phase: 1,3- donors(healthy); 4,5- patients with myocardial infarction; 2- cell texture[1]; 6-donors blood plasma after ozone influence.

The analysis of literary dates and outcomes of examination of action of ionizing radiation technological of an origin has allowed selecting groups of the patients for a taking is model plasmas of blood.

The model examinations *in vitro* with physiological solutions and solutions of phospholipids were in a parallel way carried out(spent), that in turn, allowed to improve the mechanism of a direction of an operation freely radical oxidizing *in vivo* and possible(probable) working model of an operation of ionizing radiation on plasma of blood: dissipation of energy of gamma-quantum's on molecules, resonant absorption of a scattered radiation on valence linkages, formation of fissile radicals and freely radical oxidizing before formation of filed finished products.

The obtained outcomes allow recommending the circumscribed methods and token as a sieving method of filing of an operation of ionizing radiation for biological systems in radiobiological monitoring with the recommendations at deriving reproduced effects for development of observations in cardiology centers, for example, illness of heart.

The human blood plasma proteins realize creating bonds mean the information transfer, influencing on the genetic mechanism of the cell (the table 1). It was found that the needle crystal textures of the blood plasma of the patients with myocardial infarction, in the case closer to death are characteristic of the aminoacids textures too. The high sensitivity of the polarizing microscopy method let to recommend the methods as a one from the long-term other methods of the genetic breaches find.

Table 1 The aminoacids, its conventional signs, (three and one letter symbol) and the codones are according to them, the crystal type.

A	Ala	Alanin	GCAGCCGCGGCU	dendrite
C	Cys	Cistein	UGCUGU	dendrite
D	Asp	Asparg. acid	GACGAU	dendrite
E	Glu	Glutamin. acid	GAAGAG	fanny
F	Phe	Phenilalanin	UUCUUU	dendrite
G	Gly	Glycin	GGAGGCGGGGGU	fanny
H	His	Histidin	CACCAU	fanny
I	Ile	Isoleicin	AUAAUCAUU	complex
K	Lys	Lysin	AAAAAG	dendrite
M	Met	Methionin	AUG	complex
N	Asn	Aspargin	AACAAU	dendrite
P	Pro	Prolin	CCACCCCGCCU	needle
Q	Gln	Glutamin	CAACAG	fanny
T	Thr	Threonin	ACAACCACGACU	needle
V	Val	Valin	GUAGUCGUGGUU	complex
W	Trp	Triptophan	UGG	dendrite
Y	Tyr	Tyrosin	UACUAU	needle

The investigations of the temperature dependence of the conductivity ($\lg\sigma-1/T$) at the different degrees of the plasma ozone treatments in vitro helped to show for the first time the quantitative influence of the lipids peroxide oxidation on the conductivity ($\lg\sigma=10.5\div-9.7$) as well, as more abrupt phase transition in the temperature range ($1/T=3.15\div3.09\text{ K}^{-1}$).

The researches of γ - radiation and α - radiation interaction with water systems of lecithin were carried out. Ordering of the structures has allowed establishing the markers of the threshold of direct collisions. The results are presented in figure 3. From the presented data it is visible that the big section of interaction the α - particles with a target considerably reduces the threshold of the direct collisions activity.



Figure 3 The Influence of radiation on water biological molecular system - 5 % of lecithin in water: a – 1 Sv/hour, the time of exposition is 3,6 seconds;

b - α - radiation (radon) 30 Bq/m^{-3} , the time of exposition is 2 hours.

CONCLUSION

In the conducted researches the markers of γ - radiation and α - radiation interaction with modelling molecular biological systems are established. The markers of free radical oxidation of lipids are installed. It is shown that the big section of α - particles interaction with lecithin molecules reduces the size of threshold values of α - radiation. The received results can be recommended for experimental and construction works on the creation of integrated radon radiometer.

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