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Spectroscopic Phenomenological Estimation of the Functional State of the Human Organism in Rate and Pathology

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ABSTRACT

In laboratory diagnostics uses a large amount of blood parameters to determine the functional state of the human organism. To our opinion, the evaluation may be given by the phenomenological electron spectroscopy analysis of biological liquids, which regards blood and its components as one and indivisible light-absorbing system without separating into individual compounds. Blood, plasma and serum solutions from donors and groups of patients (with pyoinflammatory diseases, therapeutic reanimation state, with renal insufficiency and cirrhosis) were studied. The difference of phenomenological characteristics of the spectra in rate and pathology was found. Results were confirmed by statistical data processing.

Keywords*: *Phenomenological*, *Absorption*, *Spectroscopy*, *Blood*, *Spectrum

1. Introduction

Methods of spectroscopy are widely used for the study of biological fluids. The authors suggested a new approach to research functional state of human organism based on electron spectrum of blood. This is an unusual aspect of electron spectroscopy has been named the electron phenomenological spectroscopy [1]. Contrary to conventional methods phenomenological spectroscopy studies substance as one indivisible system, without separating spectrum of the substance into characteristic frequencies and wavelengths of individual functional groups of components of the system.

The phenomenological approach may be used for determination the average characteristic-indexes of electronic structure for the whole system were determined on the analogy with indexes of reaction capability in chemistry of "pure substances" [1]. The problem is solved on the basis of discovered connecting between integral strength of oscillators (the area under curve of absorption of radiation in visible and UV diapason of spectrum) with ionization potentials (IP) and affinity to electron (AE) [2]. In the course of statistical research of several hundreds of atoms spectrums and organic molecules the correlation of IP and AE and integral oscillator force was established.

Except IP and AE are used three parameters of identification: the probability of light-absorbance, the factor of intensity of light-absorbance and the factor of fine structure of spectrum [2].

The integral characteristic, determined in the case of biological objects, differs from the absorption factor of molecular solutions, because absorption effects of dispersion and fluorescence are taking place. That is why the integral characteristic determined may be regarded as effective absorption factor of biological system.

In presented work were determined blood and its components as a system of quasiparticles in excited state. This way, all of physicochemical properties of such kind of system are formed by its effective energy characteristics, connected with absorption spectrums in UV and VIS radiation.

2. Experimental Procedure

We have examined 100 donors and 180 ailing people with different diagnosis and disease severity level. Absorption spectroscopy analysis of blood, plasma and serum solutions on the authoring method was carried out. Distilled water was taken as a vehicle. To determine ab-

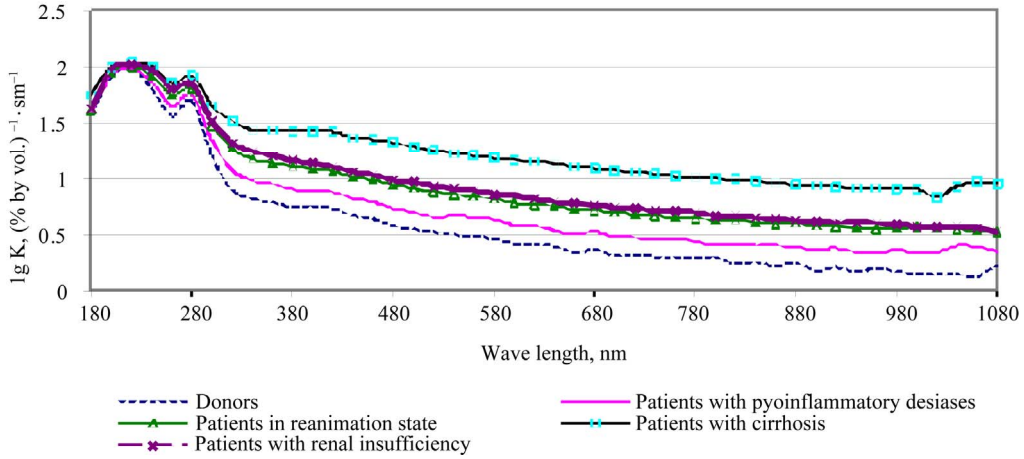

Figure 1. Four patient groups in comparison with donors (average spectrums of plasma subsystem).

Table 1. Phenomenological parameters of the absorption spectrums of plasma subsystem for donors and four groups of patients.

	Plasma				
	Donors	Patients			
		Pyoinflammatory diseases	Reanimation state	Renal insufficiency	Cirrhosis
Probability of light-absorbance, $-p\cdot10^3$, nm^{-1}					
Average value	4.7	4.651	4.362	4.46	3.356
Confidence interval $\alpha = 0.95$	0.16	0.26	0.14	0.14	0.384
Variation coefficient	16.17	22.07	10.45	10.64	32.34
Δ, nm^{-1}	--	0.045	0.334	0.24	1.34
Intensity of light-absorbance, $\times10^1$, (% by vol.)$^{-1}$·sm^{-1}					
Average value	64.63	92.13	101.61	112.24	128.8
Confidence interval $\alpha = 0.95$	5.35	6.88	11.63	8.95	14.5
Variation coefficient	39.66	29.52	37.38	26.67	22.96
Δ, (% by vol.) $^{-1}$·sm^{-1}	--	–27.5	–36.98	–47.61	–64.17
Factor of fine structure, (% by vol.)$^{-1}$·sm^{-1}					
Average value	37.46	30.43	27.36	1593.09	16.12
Confidence interval $\alpha = 0.95$	2.1	1.87	2.59	115.92	2.98
Variation coefficient	26.87	24.25	30.88	24.34	37.63
Δ, (% by vol.) $^{-1}$·sm^{-1}	--	–7.03	–10.1	1555.63	–21.34
Integral oscillator strength (IOS), θ, 10^{-7}·(% by vol.)$^{-1}$					
Average value	409.2	518.8	552.9	578.49	746.6
Confidence interval $\alpha = 0.95$	21.2	28.5	39.2	29.41	61.0
Variation coefficient	24.89	21.68	23.16	17.01	16.67
Δ, 10^{-7}·(% by vol.) $^{-1}$	--	109.6	143.7	167.2	337.4
Effective ionization potential, eV					
Average value	8.529	8.26	8.179	8.12	7.72
Confidence interval $\alpha = 0{,}95$	0.503	0.067	0.093	0.08	0.15
Variation coefficient	2.95	3.24	3.72	3.14	3.84
Δ, eV	--	–0.269	–0.35	–0.41	–0.811
Effective electron affinity, eV					
Average value	0.51	0.617	0.651	0.686	0.84
Confidence interval $\alpha = 0.95$	0.207	0.028	0.038	0.03	0.06
Variation coefficient	20.39	27.69	29.07	15.46	19.63
Δ, eV	--	0.107	0.141	0.176	0.33

sorbtion spectrums in wave-length interval from 180 to 1080 nm with step 20 nm we made solutions of 2.5 percent by volume concentration (1:40) [3,4].

3. Experimental Results

Differences between average spectrums of blood components in groups of patients (with pyoinflammatory diseases, therapeutic reanimation state, with renal insufficiency and cirrhosis) and average spectrums of blood components of donors especially became apparent for plasma (**Figure 1**).

Parameters of identification, integral strength of oscillator and effective (average value of all light-absorbing components) ionization potential were estimated in interval from 240 nm to 800 nm. Estimated integral parameters of plasma system of human blood in conditions of homeostasis (donors) and deflections from homeostasis (patients) are presented in **Table 1**.

Parameters of average effective electronic structure of plasma (effective potential of ionization and electron affinity) were calculated on the base of empiric factors, estimated for model compounds of amino acids [5]. Evident differences may be observed for the donors and in the cases of different groups of patients.

4. Discussion

Thus, correlations between functional state of human organism and deflection of phenomenological spectrum parameters of plasma from the homeostasis state have been determined. Most reliable results may be observed for absorption spectrums of plasma in interval from 240 nm to 800 nm. It is offered to use aberrations from relative "average" standard, calculated on the basis of donors, for estimation of condition of ailing or healthy organism.

5. Conclusions

Phenomenological approach enables express-evaluation of the functional state of health of human with specific phenomenological spectroscopy parameters. Such as integral strength of oscillator, effective ionization potential, electron affinity parameters of identification [6].

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