EXPERIMENTAL BIOLOGY

Frequency and Phase Correlation of Rhythms of Dihygroorotate Dehydrogenase Activity in Rat Peripheral Blood Lymphocytes and Solar Activity Rhythms and Wave Periods of Planets

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The common variation pattern and the synchronous increases of enzymatic and solar activity are explained by the identical frequencies of the bio- and heliorhythms and by the strict phase coordination of the latter. It is shown to be possible to predict enzymatic activity according to the sum of the resonance heliorhythms. The wave genesis of the resonance between enzymatic and solar fluctuations is confirmed by the fact that the periods of the bio- and heliorhythms are the same as the wave periods of planets.

Key Words: *lymphocyte dihygroorotate dehydrogenase; bio- and heliorhythms*

Recently the nature of heliobiological investigations has undergone a revolution. A newly devised mathematical method permitting scientists to isolate from the complicated dynamics of a studied index rhythms of different frequency, amplitude, and phase [5,11], makes it possible to examine the mechanism of synchronization of cosmic and biological processes. With the aid of this method integral curves of cosmic and biological processes can be broken down into individual rhythmic components, bio- and heliorhythms of the same frequencies can be detected, and their phase correlations can be studied. This method has shown the fundamental possibility of predicting the dynamics of biological indexes according to solar activity, on the basis of a mathematical determination of the resonance bio- and heliorhythms [2,10].

The aim of the present study was to examine the mechanism whereby changes in dihygroorotate dehydrogenase (DDH) activity in rat peripheral blood lymphocytes and cosmic processes are synchronized and to assess the possibility of predicting enzyme dynamics according to the sum of the resonance heliorhythms. DDH is a mitochondrial enzyme and a marker of pyrimidine biosynthesis, and it is considered as a potential therapeutic target in a number of pathologies [12]. We will study the frequency and phase correlations of the activity rhythms of this enzyme with the rhythms of the Wolf numbers (*R*, an integral characteristic of solar activity), and we will compare the periods of the bio- and heliorhythms with the wave periods of the planets [7].

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MATERIALS AND METHODS

The experiment was carried out on mongrel male albino rats weighing 166±8 g. The animals were

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TABLE 1. Rhythms of DDH and *R*. A Fragment of the Fundamental Wave Spectrum of the Solar System [7].

Rhythm	Parameters	Animal 1	2	3	4	5	6	7	Mean Value	*R*	DDH/*R* phase shift	Wave periods
	G	472±17	467±16	467±15	470±16	467±14	478±15	475±14	471±12			
2 months	T	57.00	57.00	57.00	56.92	57.00	57.00	57.00	56.99±0.02	57.00		59.12-Venus
	A	48	37	19	25	30	48	34	34	15		58.68-Mercury
	ϕ	124	152	131	138	122	130	117	131±10	142	0	56.29-Pluto
7 weeks	T	49.00	50.44		51.00	49.00		49.00	49.69±0.29			53.37-Uranus, 51.92-Venus
	A	46	34		33	34		35	36			52.97-Venus, 50.97-Venus
	ϕ	92	165		172	150		134	143±26			52.23-Venus
6 weeks	T							44.50		45.00		44.51-Mercury
	A							35		7		42.98-Neptune
	ϕ							145		184		
5 weeks	T		37.00	37.00	37.00		38.00	37.00	37.20±0.50	37.00		36.57-Mercury
	A		40	40	17		16	33	29	8		
	ϕ		147	186	183		145	169	166±23	158	0	
1 month	T	28.25	28.50	28.50	28.25	28.25	28.38	28.50	28.38±0.08	28.50		31.71-Mercury, 27.55-Mercury
	A	37	31	14	36	28	24	38	30	14		29.47-Mercury, 27.40-Uranus
	ϕ	177	174	186	217	175	182	175	184±12	185	0	28.43-Mercury, 27.28-Mercury, 27.84-Mercury, 27.06-Saturn, 27.63-Mercury
3.5 weeks	T						25.00	25.50		24.50		
	A						19	28		4		
	ϕ						220	208		234		
3 weeks	T	20.50	19.50	19.38	19.00	19.75		19.50	19.61±0.46	19.88		19.92-Saturn
	A	17	37	15	25	26		21	23	5		17.96-Saturn
	ϕ	179	182	165	207	179		144	176±19	328	180	
2.5 weeks	T	16.50	16.50	16.00		16.50	16.50	16.50	16.42±0.18	16.50		16.40-Jupiter
	A	23	23	16		30	21	26	23	4		
	ϕ	263	242	238		258	258	233	249±14	335	-90	
2 weeks	T	14.09	14.00		15.00	14.33			14.33±0.51	14.20		13.61-Saturn
	A	19	18		29	14			20	4		
	ϕ	33	329		327	344			348±49	353	0	
1.5 weeks	T	9.33	10.00	10.50	10.00	10.00			9.97±0.39	10.00		10.21-Jupiter
	A	14	24	17	30	19			21	4		
	ϕ	260	244	320	314	231			274±54	86	180	
8 days	T	8.14	8.50	8.00	8.33	8.00		8.25	8.20±0.21	8.14		8.99-Jupiter
	A	14	24	13	14	20		18	17	4		8.57-Jupiter
	ϕ	263	264	345	247		256	221	266±35	96	180	8.45-Ceres
1 week	T	6.73		6.59	6.88	6.43	7.00	7.00	6.77±0.25	6.70		7.44-Jupiter
	A	17		22	14	14	15	23	18	3		
	ϕ	53		82	55	54	62	18	54±16	59	0	
1/5 month	T	6.00	5.56	5.83	5.83	5.40		5.83	5.74±0.23	5.70		5.58-Ceres
	A	18	25	19	22	15		18	20	4		
	ϕ	215	253	207	244	181		233	222±28	136	+90	
1/6 month	T	4.38	3.92	4.38	4.67		4.63		4.40±0.32	4.38		4.85-Mars, 4.26-Ceres
	A	15	22	17	21		16		18	2		4.62-Ceres, 4.16-Earth
	ϕ	101	22	40	53		21		47±37	250	180	4.36-Ceres, 3.96-Ceres
1/8 month	T	3.47			3.62	3.67	3.36	3.36	3.50±0.19			3.74-Venus
	A	15			24	16	14	19	18			3.69-Neptune
	ϕ	163			101	18	116	103	100±51			
1/10 month	T	3.00		3.11			3.00		3.04±0.16			3.08-Mars
	A	17		15			16		16			
	ϕ	338		84			17		26±73			
1/3 week	T	2.25	2.17	2.28	2.61	2.48	2.24	2.25	2.33±0.15			2.59-Mars, 2.24-Earth
	A	28	15	18	18	19	15	17	19			2.37-Mars, 2.18-Mars
	ϕ	335	350	283	287	5	101	285	338±54			2.29-Mars, 1.97-Venus, 2.27-Mars

Note. G = mean DDH activity (number of formazan granules in 50 lymphocytes); T = period, days; A = amplitude (number of formazan granules in 50 lymphocytes); ϕ — cosine shift, showing position of first maximum on time scale, degrees.

held in the same cage under standard vivarium conditions with free access to food and water; fresh food was given after blood sampling. During 58 days (from October 11 to December 7, 1986) three blood smears were taken from the caudal vein of each animal every day at 10:00 h to determine the DDH activity, which was assessed by the number of formazan granules in 50 lymphocytes for each smear [4]. The mean value of the three smears was taken as the result.

Unknown rhythms hidden in the individual DDH dynamics and *R* dynamics, as well as their parameters, namely the mean level of activity of G (formazan granules in 50 lymphocytes), the period T (days), the amplitude of the oscillations around the mean level of A, and the phase ϕ (degrees) were determined using a described method [5,11]. Each rhythm detected was tested for the degree it differed from the noise (nonperiodic components). For proof that the rhythms significantly ($p<0.05$) differing from the noise had been identified correctly and completely, the sum of the detected rhythms was superimposed onto the baseline data and the degree of correlation was calculated using the method of multiple regression.

Sets of significant biorhythms were detected for each animal and their parameters were analyzed. Group characteristics were obtained by summing the parameters of the biorhythms belonging to the same frequency class.

RESULTS

Figure 1 presents individual changes of DDH activity in rat peripheral blood lymphocytes as well as the variations of the Wolf numbers during the experiment. The common 58-day variation and the synchronous increases in DDH and *R* presuppose the existence of phase-coordinated rhythms of similar dimensions in their spectra.

The bio- and heliorhythms and their parameters, identified after [5,11], and a fragment of the fundamental wave spectrum of the solar system [7] are listed in Table 1. Seventeen dimensions of the biorhythms in a range from 2 to 1/10 month were obtained using the method described in [5,11]. In addition to classified biorhythms [8], we identified for the first time some biorhythms in the range of one week or less. A one-week biorhythm structure comprising three components with periods of 8.20±±0.21, 6.77±0.25, and 5.74±0.23 days, was perceived.

Each animal exhibits an individual combination of biorhythms, and whereas the set of rhythms and amplitude are individual, the frequency (the period) and the phase are common to the whole group.

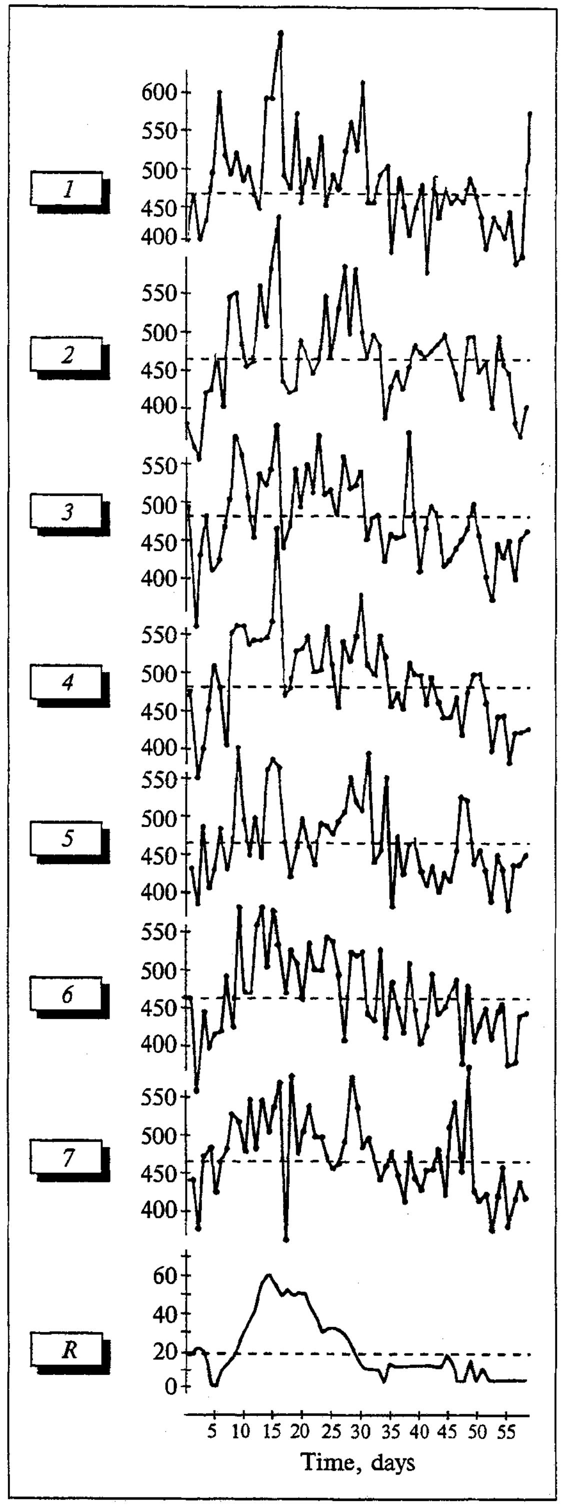

Fig. 1. Individual DDH changes in rat peripheral lymphocytes and the attendant *R* changes (November 11 – December 7, 1986). Ordinate: *1–7*) DDH activity (the number of formazan granules in 50 lymphocytes) and *R*, arbitrary units. *1–7* are rat numbers. Dashed line shows mean value of activity and *R*.

Bio- and heliorhythms of the same dimension do not differ in period length and are comparable to the wave periods of planets. Overmost of one

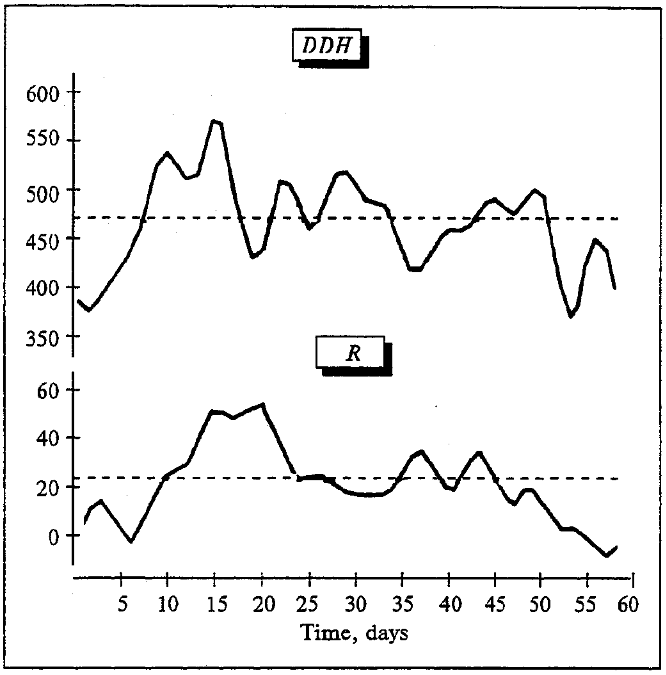

Fig. 2. Calculated curves of DDH activity and *R*, obtained by summing 7 resonance bio— and heliorhythms, respectively. Mean values of parameters were used for calculation. Ordinate: calculated values of DDH (number of formazan granules in 50 lymphocytes) and *R*, arbitrary units.

biorhythmic dimension, two or more close terms of the wave frequencies demarcating the boundaries of the given dimension correspond. Single-frequency bio- and heliorhythms may be either in-phase or out of phase, and more rarely they are shifted 1/4 period, but the nature of the coordination is stably repeated by each individual. Seven of the 11 strictly coordinated single-frequency bio- and heliorhythms are found in the vast majority of studied animals. They are: 2- and 1-month, 3- and 2.5-week, 8-day, 1-week, and 1/5 month rhythms. We obtained theoretical curves of the DDH and *R* activities by summing the 7 detected biorhythms and the 7 heliorhythms corresponding to them in period (Fig. 2). The calculated dynamics of the studied parameters confirms not only the existence of a resonance connection among them, i.e., of a solar regulation of DDH activity, but also its paramount importance for implementing the above 7 biorhythms.

Thus, there are two effects related to wave resonance: first, the periods of the rhythms discerned in the complex dynamics of enzymatic and solar activity are the same as the wave periods of the planets; second, there is a stable phase coordination of the single-frequency bio- and heliorhythms.

The concept of a Wave Universe [7] proffers the numerous examples of coincidence between the periods of observed oscillations and the periods of the fundamental wave spectrum of the solar system as evidence of wave resonance. The coincidence of the periods of bio- and heliorhythms with the wave periods of the planets, noted in this study and shown previously [2,3,9] for year, season, month, and week heliorhythms and for the rhythms of some human blood indexes, expands the range of effects related to wave resonance. It gives concrete form to the connection between living nature and the cosmos, confirming the hypothesis of A. L. Chizhevskii concerning the nature of this connection [10]. All the data go to show that the heliorhythms and the wave periods of the planets can be used as a point of reference for the identification of biorhythms; an analysis of the numerous terms of the wave frequencies in the given range may serve as a tool for classifying biorhythms.

The common pattern of changes and synchronous increases in DDH and solar activity result from a stable phase coordination of single-frequency bio- and heliorhythms. The seven detected rhythm dimensions may be considered as basic resonance characteristics, and they can be used to predict DDH fluctuations. Thus, the DDH dynamics in a range of 2 months can be assessed using the sum of 7 heliorhythms, by adding to the current phase of each heliorhythm the angle characterizing the phase shift of the paired biorhythm (Table 1). The long-range prediction of oscillations of biological parameters on the basis of the sum of the current rhythm phases of solar activity was elaborated by one of our co-authors [2].

While the discovered effects disclose the wave origin of the resonance fluctuations of enzymatic and solar activities, the biorhythms of dehydrogenases (controlling the conjugated metabolic pathways in the cell, namely α-glycerophosphate dehydrogenase and succinate dehydrogenase) studied previously confirmed the presence of resonance interactions inside the cell [6,13]. All in all, these data give a very general idea of how electromagnetic homeostasis (a term introduced by V. I. Kaznacheev [1]) is achieved.

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