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Immediate responses of the autonomic nervous system to the balneofactors, their neuro-endocrine-immune accompaniments and predictors

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Introduction. In previous studies of the Truskavets' Scientific School of Balneology, it has been shown that in response to the use of Bioactive Water Naftussya (BAWN) the activity of the autonomic nervous system changes. However, the nature of the reaction is ambiguous and is conditioned by the constellation of the initial parameters of the body [15,16,24,28]. The immediate reactions of diuresis, gastric and pancreatic secretion, hemodynamics were also interspersed [2, 6, 9, 27, 28, 31]. In the context of the adaptogenic concept of the mechanism of action BAWN [22], it is also shown that the polyversive reactions of the autonomic nervous system are accompanied by changes in some parameters of the electroencephalogram, immunogram of blood and levels of adaptation hormones in it [14-16, 24, 28]. However, the issue of the specificity of immediate effects of BAWN on the nervous, endocrine and immune systems, that function interconnected as a triple complex [15, 21, 22, 28], is still relevant. The answer to this question can be obtained by comparing the reactions of the autonomic nervous system to BAWN with reactions to ordinary (daily) water - on the one hand, and other natural adaptogens - on the other hand. This is the objective of this study.

Material and Methods. The objects of the observation were 15 volunteers-men (aged 26÷60 years, $M \pm SD$: 44±12 years) without any clinical diagnose but with a moderate dysfunction of neuroendocrine-immune complex (dysadaptation).

At first volunteers filled in a questionnaire with the purpose of estimation of the level of the trait anxiety [29]. Then EEG was recorded for 25 sec by means of the hardware-software complex 'NeuroCom Standard' (producer KhAI Medica, Kharkiv, Ukraine) monopolar in 16 loci (Fp1, Fp2, F3, F4, F7, F8, C3, C4, T3, T4, P3, P4, T5, T6, O1, O2) by 10-20 international system, with the reference electrodes A and Ref on tassels of the ears. Among the options the average EEG amplitude (μV) was considered as well as the modal frequency (Hz), frequency deviation (Hz), index (%), coefficient of asymmetry (%), absolute ($\mu V^2/Hz$) and relative (%) power spectrum density (SPD) of basic rhythms: δ (35÷13 Hz), α (13÷8 Hz), θ (8÷4 Hz) and δ (4÷0,5 Hz) in all loci, according to the instructions of the device. In addition, the Laterality Index (LI) for SPD of each rhythm was calculated using the formula [18]:

$$LI, \% = \Sigma [200 \cdot (\text{Right} - \text{Left}) / (\text{Right} + \text{Left})] / 8.$$

For each locus the Entropy (h) of normalized SPD was also calculated by using classical CE Shannon's formula [30]:

$$h = - [SPD\alpha \cdot \log_2 SPD\alpha + SPD\delta \cdot \log_2 SPD\delta + SPD\theta \cdot \log_2 SPD\theta + SPD\delta \cdot \log_2 SPD\delta] / \log_2 4$$

Then the electrocardiogram in II lead was recorded for 7 min to assess the parameters of the heart rate variability (HRV) (the hardware-software complex “CardioLab+HRV” “KhAI-MEDICA”, Kharkiv). For further analysis the following parameters HRV were selected: a) Bayevskiy’s parameters: heart rate (HR), the moda (Mo), the amplitude of moda (AMo), variational sweep (MxD-Mn), Stress Index (BSI=AMo/2 • Mo • MxD-Mn) as well as the Activity Regulatory Systems Index (BARSi) [1]; b) Temporal parameters (Time Domain Methods): the standard deviation of all NN intervals (SDNN), the square root of the sum of the squares of differences between adjacent NN intervals (RMSSD), the percent of interval differences of successive NN intervals is greater than 50 ms (pNN50), triangular index (TNN); c) Spectral parameters (Frequency Domain Methods): SP of HRV bands: high-frequency (HF, range 0,4÷0,15 Hz), low-frequency (LF, range 0,15÷0,04 Hz), very low-frequency (VLF, range 0,04÷0,015 Hz) and ultra low-frequency (ULF, range 0,015÷0,003 Hz) [4, 10].

The Leukocytogram counted up in the portion of capillary blood and its Adaptation as well as Strain Indexes by I.L. Popovych were calculated [3, 20]. The phagocytic function of neutrophils can be judged by the activity (percentage of neutrophils, in which found microbes - Phagocytic Index, PhI), intensity (number of microbes absorbed in one phagocyte - Microbial Count, MC) and the completeness (percentage of dead microbes - Killing Index, KI) [5, 8, 22] of phagocytosis museum culture *Staphylococcus aureus* (ATCC N 25423 F49) obtained from the Truskavets’ Laboratory of Hydrogeological Regime-Operational Station spa. Based on these parameters the bactericidal capacity of blood neutrophils (BCCN) was calculated by using the formula [22]:

$$\text{BCCN}(10^9 \text{Micr/L}) = \text{Leukocytes}(10^9/\text{L}) \cdot \text{Neutrophils}(\%) \cdot \text{PhI}(\%) \cdot \text{MC}(\text{Micr/Phag}) \cdot \text{KI}(\%)$$

The immune status was evaluated on a set of I and II levels recommended by the WHO. For phenotyping subpopulations of lymphocytes such methods were used as the method of rosette formation and indirect immunofluorescent binding reaction of monoclonal antibodies from the company “Sorbent” (RF) with visualization under the fluorescent microscope. T-cellular immunity was assessed by the following parameters: blood levels of a subpopulation of “active”, theophylline resistance and sensitive T-lymphocytes as well as lymphocytes phenotype of CD3⁺CD4⁺(T-helper) and CD3⁺CD8⁺ (T-cytolytic). In addition CD16⁺-lymphocytes (natural killers) were determined. The state of the humoral immunity was evaluated by the content of CD19⁺ B-lymphocytes and concentration of immunoglobulins classes G, A, M in serum (the radial immunodiffusion method) and circulating immune complexes (with polyethylene glycol precipitation method) by using standardized methods described in the manual [17].

In plasma of venous blood the content of principal adaptation Hormones was determined such as Cortisol, Testosterone and Triiodothyronine (by the ELISA with the help of the analyzer “Tecan”, Oesterreich) and the corresponding sets of reagents from “AlkorBio”, RF as well as Na⁺ and K⁺ (by the method of flaming photometry with the use of “SF-46” PFMU 4.2 for evaluating the Mineralocorticoid activity as (Na/K)^{0.5} Ratio [24].

After the registration on Basal Level 5 volunteers for some days consumed 200 mL of Control Waters (distillated, filtered, well), Water Naftussya from the layers of Truskavets’ and Skhidnyts’a, while 10 volunteers consumed 5 mL of Phytocomposition “Balm Cryms’kyi” (it is identified as an adaptogen [19]) soluted in 195 mL of daily Water. All tests were repeated in an hour and a half.

Normal values have been borrowed from the instructions for devices and sets as well as databases of the Truskavets’ Scientific School.

Results were processed by using the software package “Statistica 5.5”.

Results and discussion. The cohort characterized by dysadaptation was observed, high frequently of Dysharmonious General Adaptation Reactions

(53,7%) and Distress (11,1%) were documented, Popovych’s Leukocytary Adaptation Index ($1,03 \pm 0,08$ points vs range of norm $1,46 \div 1,95$) has decreased, while Popovych’s Leukocytary Strain Index ($0,35 \pm 0,07$ vs 0 in norm) has increased as well as Bayevskiy’s Stress Index ($5,34 \pm 0,15$ vs $4,82 \pm 0,03$ ln units in norm) and Bayevskiy’s Activity Regulatory Systems Index ($4,62 \pm 0,82$ units vs range of norm $0 \div 3$).

As the integral response criterion of the autonomic nervous system, Bayevskiy’s Stress Index is changing based on our preliminary data [25] that this HRV parameter correlates with EEG parameters more closely than the LF/HF ratio: $R=0,80$ vs $0,56$. The preliminary analysis confirmed the polyvariant nature of the vegetotropic reactions to the stimulus, namely: Bayevskiy’s Stress Index has increased in half of observations, while in 39% it decreased, and only in 11% was not significantly changed. Despite the expectations, no differences were found between the effects of all applied stimuli, so they were not considered separately at the next stage of the analysis.

The vagotonic reaction is accompanied by the increase of Variational Sweep (Table 1), SDNN, Triangulary Index and SP LF band HRV (Table 2) in combination with the decrease of Amplitude of Moda (Table 1). On the contrary, the sympathetic response is associated with the decrease of Variational Sweep, Moda, SDNN, RMSSD, pNN50, Triangulary Index and SP of all bands HRV in combination with the increase of Amplitude of Moda, Heart Rate and Bayevskiy’s Activity Regulatory Systems Index. The neutral vegetotropic reaction has not changed any of the parameters of the HRV, which is quite understandable.

Table 1

Comparative characteristics of Bayevskiy’s parameters of Heart Rate Variability

Variables	Term	Immediate vegetotropic reaction (n)			Norma- tives (n=54)
		Vagotonic (21)	Neutral (6)	Sympathotonic (27)	
Bayevskiy’s Stress Index, ln units	Before	$5,92 \pm 0,30^*$	$5,53 \pm 0,22^*$	$4,86 \pm 0,12$	$4,82 \pm 0,03$
	After	$5,35 \pm 0,22^*$	$5,57 \pm 0,19^*$	$5,37 \pm 0,11^*$	
	Change	$-0,57 \pm 0,14^\#$	$+0,04 \pm 0,04$	$+0,61 \pm 0,08^\#$	
Amplitude of Moda, %	Before	$66 \pm 5^*$	$55 \pm 6^*$	43 ± 3	$37,8 \pm 1,3$
	After	$51 \pm 4^*$	$55 \pm 6^*$	$58 \pm 4^*$	
	Change	$-15 \pm 3^\#$	0 ± 2	$+15 \pm 3^\#$	
Variational Sweep, msec	Before	$160 \pm 21^*$	$154 \pm 19^*$	$210 \pm 12^*$	252 ± 8
	After	$185 \pm 22^*$	$147 \pm 17^*$	170 ± 118	
	Change	$+25 \pm 9^\#$	-6 ± 7	$-40 \pm 8^\#$	
Moda, msec	Before	$784 \pm 34^*$	$728 \pm 45^*$	808 ± 27	864 ± 14
	After	$772 \pm 36^*$	$728 \pm 31^*$	$750 \pm 26^*$	
	Change	-12 ± 18	0 ± 37	$-58 \pm 17^\#$	
Heart Rate, beats/min	Before	$76,8 \pm 3,5$	$80,4 \pm 4,1^*$	$74,6 \pm 2,3$	$69,3 \pm 1,5$
	After	$77,9 \pm 3,1^*$	$81,7 \pm 2,8^*$	$80,0 \pm 2,6^*$	
	Change	$+1,1 \pm 1,5$	$+1,3 \pm 3,2$	$+5,4 \pm 1,5^\#$	

* Average values that are significant ($p < 0,05$) differ from normal, are indicated.
Changes are calculated as direct differences between individual values after and before drinking. Significant changes are marked.

Regarding the concomitant changes in the hormones of adaptation, a significant increase in Testosterone levels has been observed after the vagotonics reaction and a tendency towards the decrease in the sympathetic response, however, with the neutral reaction the changes have been uncertain. Equally uncertain were the changes on levels of Cortisol and Triiodothyronine as well as the Mineralocorticoid activity (Table 3). The Popovych’s Leukocytary Strain index was also significantly reduced only in the vagotonic response which reflects the decrease in the deviation from the optimum zone of elements of Leukocytogram, mainly monocytes.

Table 2

Comparative characteristics of Temporal and Spectral parameters of Heart Rate Variability

Variables	Term	Immediate vegetotropic reaction (n)			Norma- tives (n=54)
		Vagotonic (21)	Neutral (6)	Sympathotonic (27)	
SDNN, msec	Before	35 ± 3*	34 ± 5*	47±3*	57 ± 2
	After	41 ± 5*	32 ± 4*	36±3*	
	Change	+6 ± 2#	+3 ± 3	-11±2#	
RMSSD, msec	Before	22 ± 3*	16 ± 3*	28 ± 3	32 ± 3
	After	23 ± 3*	16 ± 2*	22 ± 3*	
	Change	+1 ± 1	0 ± 3	-6 ± 2#	
pNN50, %	Before	5,3 ± 2,5	1,6 ± 1,0*	8,8 ± 2,7	10,6 ± 2,2
	After	5,9 ± 2,6	1,6 ± 0,6*	4,8 ± 2,1	
	Change	+0,6 ± 0,4	0,0 ± 0,9	-4,0 ± 1,5#	
Triangulary Index, units	Before	7,4 ± 0,7*	7,9 ± 1,1*	10,9 ± 0,8	11,2 ± 0,3
	After	9,2 ± 0,9*	8,0 ± 0,9*	8,6 ± 0,7*	
	Change	+1,9 ± 0,3#	+0,1 ± 0,7	-2,2 ± 0,4#	
HF, msec ²	Before	234 ± 100	100 ± 33*	453 ± 146	413 ± 76
	After	278 ± 132	105 ± 30*	275 ± 92	
	Change	+44 ± 33	+5 ± 32	-178 ± 68#	
LF, msec ²	Before	581 ± 102	322 ± 132*	921 ± 120	741 ± 53
	After	748 ± 132	328 ± 118*	641 ± 110	
	Change	+167 ± 65#	+6 ± 42	-280 ± 119#	
VLF, msec ²	Before	441 ± 72*	611 ± 123*	1005 ± 57*	1495 ± 118
	After	764 ± 287*	572 ± 154*	573 ± 120*	
	Change	+323 ± 253	-40 ± 44	-432 ± 79#	
ULF, msec ²	Before	71 ± 22	172 ± 50	170 ± 42	122 ± 17
	After	141 ± 56	120 ± 60	70 ± 20	
	Change	+70 ± 51	-52 ± 54	-100 ± 41#	
Bayevskiy's Activity Regulatory Systems Index, units	Before	4,5 ± 0,8*	3,6 ± 0,9*	2,8 ± 0,5*	1,5 ± 0,2
	After	4,1 ± 0,7*	4,6 ± 0,9*	4,5 ± 0,5*	
	Change	-0,4 ± 0,5	+1,0 ± 0,7	+1,7 ± 0,4#	

Table 3

Comparative characteristics of principal Hormonal and Leukocytary markers of General Adaptation Reactions

Variables	Term	Immediate vegetotropic reaction (n)			Norma- tives (n=54)
		Vagotonic (21)	Neutral (6)	Sympathotonic (27)	
Cortisol, nM/L	Before	644 ± 95*	553 ± 114	496 ± 40	405 ± 23
	After	526 ± 64	538 ± 186	432 ± 53	
	Change	-118 ± 87	-15 ± 151	-64 ± 46	
(Nap/Kp) ^{0,5} as Mineralo- corticoid Activity, units	Before	6,64 ± 0,06*	6,47 ± 0,07*	6,53 ± 0,02*	5,65 ± 0,11
	After	6,58 ± 0,03*	6,45 ± 0,09*	6,54 ± 0,02*	
	Change	-0,07 ± 0,05	-0,03 ± 0,07	+0,01 ± 0,02	
Triiodo- thyronine, nM/L	Before	1,87 ± 0,04*	1,73 ± 0,06*	1,90 ± 0,04*	2,20 ± 0,09
	After	1,84 ± 0,04*	1,81 ± 0,06*	1,89 ± 0,03*	
	Change	-0,03 ± 0,02	+0,07 ± 0,11	-0,01 ± 0,03	
Testosterone, nM/L	Before	24,2 ± 1,9	27,2 ± 3,9	28,2 ± 1,5	25,2 ± 1,2
	After	27,1 ± 2,0	20,4 ± 3,6	24,7 ± 1,7	
	Change	+2,9 ± 1,4#	-6,8 ± 4,7	-3,4 ± 2,3	

Popovych's Leukocyetary Adaptation Index, points	Before After Change	0,84 ± 0,12* 1,00 ± 0,12* +0,16 ± 0,10	0,98 ± 0,22* 1,47 ± 0,31 +0,49 ± 0,31	1,18 ± 0,12* 1,17 ± 0,12* -0,01 ± 0,15	1,70 ± 0,04
Popovych's Leukocyetary Strain Index, units	Before After Change	0,56 ± 0,17* 0,27 ± 0,08* -0,29 ± 0,14#	0,34 ± 0,14* 0,58 ± 0,34 +0,24 ± 0,23	0,19 ± 0,04* 0,16 ± 0,03* -0,03 ± 0,05	0

Among the parameters of Phagocytosis, no significant changes were detected in all variants of the vegetotropic reaction (Table 4).

Among the parameters of Cellular Immunity, only T-cytolytic Lymphocytes level has elevated significantly by sympathetic response (Table 5).

Table 4

Comparative characteristics of parameters of Phagocytosis

Variables	Term	Immediate vegetotropic reaction (n)			Norma- tives (n=54)
		Vagotonic (21)	Neutral (6)	Sympathotonic (27)	
Total Leukocytes, 10 ⁹ /L	Before After Change	6,36 ± 0,41 6,68 ± 0,39 +0,31 ± 0,57	6,21 ± 0,24 6,21 ± 0,45 0,00 ± 0,50	6,11 ± 0,27 6,35 ± 0,34 +0,24 ± 0,39	5,78 ± 0,33
Neutrophiles, %	Before After Change	60,1 ± 1,3* 59,3 ± 1,3 -0,8 ± 1,2	53,6 ± 2,8 53,6 ± 2,9 0,0 ± 2,7	59,7 ± 1,2 58,9 ± 1,3 -0,8 ± 0,9	56,5 ± 1,8
Phagocytose Index, %	Before After Change	87,1 ± 1,2* 86,7 ± 0,9* -0,4 ± 1,2	85,7 ± 1,3* 86,0 ± 1,2* +0,3 ± 1,8	86,8 ± 0,9* 86,7 ± 0,9* -0,1 ± 0,9	80,0 ± 1,5
Microbial Count, Microbas/ Phagocyte	Before After Change	14,4 ± 0,6 14,4 ± 0,6 0,0 ± 0,6	14,5 ± 1,3 15,5 ± 1,9 +1,0 ± 1,6	14,1 ± 0,5 13,9 ± 0,6 -0,3 ± 0,5	14,4 ± 0,8
Killing Index, %	Before After Change	32 ± 4 31 ± 3* 0 ± 2	33 ± 4 31 ± 5 -2 ± 4	38 ± 2 35 ± 2 -3 ± 2	40 ± 2
Bactericidal Capacity, 10 ⁹ Microbas/L	Before After Change	14,6 ± 1,7 15,3 ± 2,0 +0,8 ± 1,8	13,2 ± 1,5 12,7 ± 1,9 -0,5 ± 1,5	16,6 ± 1,2 15,0 ± 1,2 -1,6 ± 1,3	15,0 ± 0,9

Table 5

Comparative characteristics of parameters of Cellular Immunity

Variables	Term	Immediate vegetotropic reaction (n)			Norma- tives (n=54)
		Vagotonic (21)	Neutral (6)	Sympathotonic (27)	
Total Lymphocytes, 10 ⁹ /L	Before After Change	2,31 ± 0,13* 2,26 ± 0,10* -0,05 ± 0,12	2,23 ± 0,07* 2,24 ± 0,16 0,00 ± 0,13	2,23 ± 0,10* 2,26 ± 0,09* +0,03 ± 0,11	1,96 ± 0,04
“Active” T-Lymphocytes, %	Before After Change	26,6 ± 1,1* 25,4 ± 0,6* -1,2 ± 0,7	26,8 ± 1,5 27,2 ± 2,0 +0,4 ± 0,6	25,6 ± 0,6* 25,4 ± 0,8* -0,2 ± 0,7	29,6 ± 0,8
Theophilline resistance T-Lymphocytes, %	Before After Change	21,9 ± 0,8* 22,1 ± 0,9* +0,2 ± 1,0	30,0 ± 4,5 28,7 ± 3,1 -1,3 ± 3,1	21,9 ± 1,2* 23,1 ± 1,2* +1,2 ± 1,2	33,2 ± 1,2

T-helper Lymphocytes, %	Before After Change	23,9 ± 0,6* 23,5 ± 0,4* -0,4 ± 0,8	27,5 ± 1,9 26,9 ± 1,7 -0,6 ± 1,3	23,6 ± 0,8* 23,0 ± 0,8* -0,6 ± 0,8	29,1 ± 1,0
Theophilline sensitive T-Lymphocytes, %	Before After Change	20,6 ± 1,1 18,5 ± 1,3 -2,2 ± 1,7	16,9 ± 3,5 14,1 ± 3,6 -2,8 ± 5,6	18,2 ± 1,1* 19,4 ± 1,2 +1,2 ± 1,5	20,9 ± 0,4
CD8+CD3+ T-cytolytic Lymphocytes, %	Before After Change	27,9 ± 0,5* 26,8 ± 0,8* -1,1 ± 0,8	26,2 ± 1,0 24,6 ± 1,5 -1,7 ± 1,9	27,1 ± 0,6* 28,3 ± 0,8* +1,3 ± 0,6#	24,8 ± 0,5
CD16+ NK- Lymphocytes, %	Before After Change	11,4 ± 0,8* 12,2 ± 0,7* +0,8 ± 0,5	11,3 ± 1,1* 11,2 ± 1,5* -0,1 ± 1,2	11,7 ± 0,5* 11,5 ± 0,7* -0,2 ± 0,7	16,4 ± 0,8
0-Lymphocytes, %	Before After Change	14,2 ± 1,2* 16,1 ± 1,5* +1,9 ± 1,7	12,9 ± 4,0 14,4 ± 5,2 +1,5 ± 4,1	16,2 ± 1,7* 16,5 ± 2,0* +0,3 ± 2,3	8,0 ± 0,8

None of the parameters of Humoral Immunity has changed significantly for all variants of the vegetotropic reaction (Table 6).

Table 6

Comparative characteristics of parameters of Humoral Immunity

Variables	Term	Immediate vegetotropic reaction (n)			Norma- tives (n=54)
		Vagotonic (21)	Neutral (6)	Sympathotonic (27)	
CD19+ B-Lym- phocytes, %	Before After Change	22,6 ± 0,9 21,3 ± 1,0 -1,3 ± 1,1	22,0 ± 2,7 23,0 ± 2,2 +1,0 ± 3,0	21,5 ± 0,9 20,8 ± 1,0 -0,8 ± 1,4	21,7 ± 0,8
Immuno- globulins M, g/L	Before After Change	1,52 ± 0,09* 1,61 ± 0,12* +0,10 ± 0,11	1,45 ± 0,29 1,20 ± 0,23 -0,25 ± 0,24	1,36 ± 0,09* 1,48 ± 0,08* +0,12 ± 0,08	1,15 ± 0,05
Immuno- globulins G, g/L	Before After Change	12,9 ± 1,3 11,6 ± 1,3 -1,4 ± 1,4	15,0 ± 3,6 16,5 ± 2,8 +1,6 ± 1,7	12,7 ± 1,3 11,7 ± 1,4 -1,0 ± 1,0	11,5 ± 0,4
Immuno- globulins A, g/L	Before After Change	1,40 ± 0,07* 1,37 ± 0,13* -0,03 ± 0,14	1,19 ± 0,15* 1,60 ± 0,43 +0,40 ± 0,41	1,27 ± 0,05* 1,26 ± 0,06* -0,01 ± 0,23	1,90 ± 0,06
Circulating Immune Complexes, units	Before After Change	74 ± 24 52 ± 11 -22 ± 20	42 ± 4 35 ± 5* -7 ± 5	38 ± 3* 33 ± 3* -4 ± 3	54 ± 5

Since the number of registered EEG parameters is 164, we limited its number to only 15, and then their changes have been proved to be characteristic of the vegetotropic reactions (Table 7). As it can be seen, the vagotonic reaction is associated with the significant increase in the β -rhythm Index and the decrease in its SPD in locus T5. Instead, the sympathetic response is accompanied by the decrease in the Frequency of α -rhythm and its SPD in the loci T5 and F7 as well as by the increase in the Entropy of SPD in locus O1.

Now let's turn to the presentation of the results of the already mentioned discriminant analysis which was conducted to identify the parameters of the neuroendocrine-immune complex, among the totality of **changes** three variants of the vegetotropic reaction differ significantly among themselves, that is, they are discriminational [13].

The program (forward stepwise) included 27 parameters (variables) in the model. In addition the Baevskiy's Stress Index, 3 parameters of **HRV**, 15 of

EEG and 7 of Immunity as well as Testosterone were identified as recognizable (Table 8).

Table 7

Comparative characteristics of selected parameters of EEG

Variables	Term	Immediate vegetotropic reaction (n)			Norma- tives (n=54)
		Vagotonic (21)	Neutral (6)	Sympathotonic (27)	
T5-α SPD, μV ² /Hz	Before After Change	75±22 80±22 +4±9	114±59 163±108 +50±51	122±28 97±21 -25±11 [#]	134±16
T5-α SPD, %	Before After Change	26,8±3,7 29,6±4,2 +2,8±2,4	38,1±8,3 37,0±10,5 -1,1±6,5	35,5±3,9 30,3±3,1 -5,2±2,0 [#]	36,8±2,3
T5-β SPD, %	Before After Change	46±4 37±4 -8,4±3,0 [#]	35±8 33±10 -1,4±4,6	39±4 39±4 -0,5±3,7	36,8±2,4
F7-θ SPD, μV ² /Hz	Before After Change	14,5±3,2 14,0±2,3 -0,5±3,0	12,2±3,0 11,1±3,5 -1,1±4,7	13,8±1,7 20,4±3,8 +6,6±3,5	16,0±1,6
Fp1-δ SPD, %	Before After Change	21,8±3,6 23,5±4,7 +1,7±5,4	10,6±1,7 37,2±16,1 +26,6±16,3	18,0±2,3 22,1±3,7 +4,1±4,1	18,9±1,4
Frequency of α-rhythm, Hz	Before After Change	10,64±0,19 10,48±0,22 -0,17±0,23	10,58±0,27 11,08±0,52 +0,50±0,34	10,52±0,18 10,48±0,15 -0,24±0,06 [#]	10,43±0,08
Asymmetry of β-rhythm, %	Before After Change	24±5 17±2 -7,4±4,9	28±10 28±10 -0,3±5,6	16±2 17±3 +0,4±2,2	20±1,5
F8-β SPD, μV ² /Hz	Before After Change	77±22 66±20 -11±18	43±15 46±13 +3±6	66±14 51±7 -15±12	69±9
F4-δ SPD, μV ₂ /Hz	Before After Change	150±70 85±14 -65±65	54±14 119±69 +65±78	77±14 229±141 +152±143	89±9
F7-α SPD, %	Before After Change	25±3 28±4 +3,2±2,6	29±7 33±8 +4,1±7,3	32±3 26±3 -6,4±2,3 [#]	31,7±2,0
Fp1-α SPD, %	Before After Change	34±4 36±5 +2,0±2,8	41±9 28±11 -13±9	40±3 36±3 -3,6±2,5	44,0±2,2
Index of β-rhythm, %	Before After Change	76,1±6,0 88,6±2,0 +12,5±6,0 [#]	91,3±5,7 94,2±2,4 +2,8±5,8	92,0±2,8 89,9±3,0 -2,0±4,0	87,9±1,8
Entropy of SPD in O1	Before After Change	0,74±0,04 0,76±0,04 +0,03±0,04	0,78±0,05 0,70±0,06 -0,08±0,06	0,71±0,03 0,76±0,03 +0,05±0,02 [#]	0,68±0,02
Entropy of SPD in F4	Before After Change	0,82±0,03 0,86±0,02 +0,03±0,03	0,87±0,05 0,83±0,04 -0,04±0,04	0,85±0,02 0,85±0,03 0,00±0,03	0,83±0,01
Entropy of SPD in P4	Before After Change	0,84±0,03 0,78±0,03 -0,06±0,02 [#]	0,83±0,04 0,79±0,05 -0,05±0,05	0,79±0,03 0,80±0,02 +0,01±0,02	0,76±0,01

The program (forward stepwise) included 27 parameters (variables) in the model. In addition the Baevskiy’s Stress Index, 3 parameters of HRV, 15 of EEG and 7 of Immunity as well as Testosterone were identified as recognizable (Table 8).

Table 8

Discriminant Function Analysis Summary

Step 27, N of variables in model: 27; Grouping: 3 groups
Wilks’ Lambda: 0,0179; approximately. $F_{(54)}=6,0$; $p<10^{-6}$

Variables currently in model	Wilks’ Λ	Partial Λ	F-remove	p-level	Tolerancy
Baevskiy’s Stress Index, ln units	,023	,788	3,4	,051	,125
Triangular Index, units	,021	,857	2,1	,145	,348
T5-α SPD, $\mu V^2/Hz$	,022	,808	3,0	,070	,379
T5-β SPD, %	,027	,657	6,5	,005	,220
F7-θ SPD, $\mu V^2/Hz$	,026	,683	5,8	,009	,259
Fp1-δ SPD, %	,019	,957	,6	,579	,103
Frequency of α-rhythm, Hz	,031	,579	9,1	,001	,298
Stub Neutrophils, %	,024	,755	4,1	,030	,313
HF SP, msec ²	,021	,868	1,9	,170	,520
Popovych’s Adaptation Index, points	,024	,748	4,2	,027	,025
Asymmetry of β-rhythm, %	,022	,830	2,6	,098	,370
CD8+CD3+ T-cytolyt Lymphoc., %	,021	,835	2,5	,106	,365
Entropy of SPD in O1	,026	,700	5,4	,012	,294
Popovych’s Strain Index, units	,030	,605	8,2	,002	,256
Testosterone, nM/L	,021	,859	2,1	,149	,030
F8-β SPD, $\mu V^2/Hz$	,022	,820	2,7	,084	,424
F4-δ SPD, $\mu V^2/Hz$	,018	,984	0,2	,816	,215
F7-α SPD, %	,039	,459	14,7	,000	,089
Fp1-α SPD, %	,029	,621	7,6	,003	,059
T5-α SPD, %	,021	,832	2,5	,100	,317
LF SP, msec ²	,022	,808	3,0	,069	,287
IgA, g/L	,022	,806	3,0	,067	,261
IgM, g/L	,020	,895	1,5	,249	,435
Entropy of SPD in F4	,023	,793	3,3	,055	,168
“Active” T-Lymphocytes, %	,021	,851	2,2	,134	,302
Entropy of SPD in P4	,020	,903	1,3	,279	,403
Index of β-rhythm, %	,019	,920	1,1	,355	,608

The recognition information contained in the listed variables is condensed in two discriminant roots, 62% in the first and 38% in the second. The values of individual roots were calculated by adding products of discriminant variables to their Raw Coefficients plus the Constant (Table 9) makes it possible to visualize each vegetotropic reaction together with its neuroendocrine-immune accompaniment in a two-dimensional information space of radicals (Fig. 1).

Table 9

Summary of Stepwise Analysis and Coefficients and Constants
for Canonical Variables

Variables currently in the model	Parameters of Wilks' Statistics					Standardized Coefficients		Raw Coefficients	
	F to enter	p- level	Λ	F- value	p- level	Root 1	Root 2	Root 1	Root 2
Baevskiy's Stress Index, ln un.	33,3	10 ⁻⁶	,434	33,3	10 ⁻⁶	-1,201	,699	-2,413	1,405
Triangulary Index, units	5,2	,009	,360	16,7	10 ⁻⁶	,627	-,269	,332	-,143
T5-α SPD, μV ² /Hz	2,6	,088	,326	12,3	10 ⁻⁶	-,277	,725	-,004	,011
T5-β SPD, %	2,6	,082	,293	10,2	10 ⁻⁶	-1,097	,761	-,066	,046
F7-θ SPD, μV ² /Hz	4,9	,012	,243	9,7	10 ⁻⁶	-1,084	,454	-,068	,028
Fp1-δ SPD, %	3,8	,029	,208	9,1	10 ⁻⁶	-,427	-,549	-,017	-,022
Frequency of α-rhythm, Hz	3,1	,055	,183	8,6	10 ⁻⁶	-,002	1,301	-,001	1,087
Stub Neutrophils, %	2,5	,097	,165	8,1	10 ⁻⁶	,085	-,964	,045	-,518
HF SP, msec ²	2,3	,113	,149	7,6	10 ⁻⁶	,534	-,012	,00196	-45•10 ⁻⁶
Popovych's Adaptation Index	2,7	,080	,132	7,4	10 ⁻⁶	-1,274	3,228	-1,911	4,841
Asymmetry of β-rhythm, %	2,6	,084	,117	7,2	10 ⁻⁶	-,306	,671	-,018	,040
CD8+CD3+ T-c Lymphocytes	3,7	,034	,099	7,3	10 ⁻⁶	-,703	-,111	-,192	-,030
Entropy of SPD in O1	2,1	,141	,089	7,0	10 ⁻⁶	-,432	-1,013	-2,803	-6,571
Popovych's Strain Index, units	2,1	,135	,080	6,9	10 ⁻⁶	,055	1,359	,120	2,939
Testosterone, nM/L	1,8	,174	,073	6,7	10 ⁻⁶	-1,162	2,058	-,115	,204
F8-β SPD, μV ² /Hz	2,2	,129	,065	6,6	10 ⁻⁶	,630	-,291	,009	-,004
F4-δ SPD, μV ² /Hz	1,8	,173	,059	6,4	10 ⁻⁶	,290	,002	51•10 ⁻⁵	3•10 ⁻⁶
F7-α SPD, %	1,8	,188	,054	6,3	10 ⁻⁶	,610	2,625	,048	,206
Fp1-α SPD, %	4,9	,014	,041	6,8	10 ⁻⁶	-,558	-2,719	-,040	-,193
T5-α SPD, %	2,0	,147	,037	6,8	10 ⁻⁶	-,302	-,734	-,027	-,065
LF SP, msec ²	1,9	,168	,033	6,7	10 ⁻⁶	-,039	,895	-8•10 ⁻⁵	,0019
IgA, g/L	1,8	,181	,029	6,6	10 ⁻⁶	,218	,918	,365	1,538
IgM, g/L	1,2	,305	,027	6,4	10 ⁻⁶	,357	,393	,755	,831
Entropy of SPD in F4	1,7	,198	,024	6,4	10 ⁻⁶	,842	,845	5,241	5,259
“Active” T-Lymphocytes, %	1,7	,205	,021	6,3	10 ⁻⁶	-,347	-,678	-,108	-,211
Entropy of SPD in P4	1,3	,300	,019	6,2	10 ⁻⁶	-,515	-,071	-4,929	-,677
Index of β-rhythm, %	1,1	,355	,018	6,0	10 ⁻⁶	,305	,239	,013	,010
Constants								,2698	-,0003
Discriminant Properties								62%	38%

It can be seen that all three clusters are delimited so clearly that they do not need to compute Mahalanobis distances between them.

The placement of points of the cluster of the vagotonic reaction in the positive region of the first root reflects the increase (meaningful or as a tendency) in this situation parameters correlate with this root positively and reduce the parameters that are associated with it negatively. Instead, the opposite localization along the axis of the first root of the sympathetic cluster reflects the opposite or less noticeable changes of the same parameters (Table 1).

Fig. 1. Localization of individual values of roots of vegetotropic reactions together with its neuroendocrine-immune accompaniment in a two-dimensional information space of radicals

Table 10

Factor Structure Matrix (Correlations Variables - Canonical Roots) and Means of Changes in Variables by Vegetotropic Reaction

Variables currently in the model	Root 1	Root 2	Means of Changes by Vegetotropic Reaction		
			Vagotonic	Neutral	Sympathotonic
Triangulary Index, units	,364	-,015	+1,9±0,3 [#]	+0,1±0,7	-2,2±0,4 [#]
Stub Neutrophils, %	,175	,002	+1,13±0,38 [#]	+0,42±0,86	-0,80±0,37 [#]
LF SP, msec ²	,156	,003	+167±65 [#]	+6±42	-280±119 [#]
HF SP, msec ²	,139	,024	+44±33	+5±32	-178±68 [#]
F7-α SPD, %	,131	,052	+3,2±2,6	+4,1±7,3	-6,4±2,3 [#]
T5-α SPD, %	,118	-,010	+2,8±2,4	-1,1±6,5	-5,2±2,0 [#]
T5-α SPD, μV ² /Hz	,091	,128	+4±9	+50±51	-25±11 [#]
Index of β-rhythm, %	,103	-,025	+12,5±6,0 [#]	+2,8±5,8	-2,0±4,0
Testosterone, nM/L	,096	-,103	2,9±1,4 [#]	-6,8±4,7	-3,4±2,3
Baevskiy's Stress Index, ln units	-,394	,047	-0,57±0,14 [#]	+0,04±0,04	+0,61±0,08 [#]
Entropy of SPD in P4	-,111	-,019	-0,06±0,02 [#]	-0,05±0,05	+0,01±0,02
Popovych's Strain Index, units	-,081	,135	-0,29±0,14 [#]	+0,24±0,23	-0,03±0,05
T5-β SPD, %	-,077	,034	-8,4±3,0 [#]	-1,4±4,6	-0,5±3,7
CD8+CD3+ Tc-Lymphocytes, %	-,114	-,059	-1,1±0,8	-1,7±1,9	+1,3±0,6 [#]
Asymmetry of β-rhythm, %	-,076	,035	-7,4±4,9	-0,3±5,6	+0,4±2,2
F7-θ SPD, μV ² /Hz	-,078	-,030	-0,5±3,0	-1,1±4,7	+6,6±3,5
F4-δ SPD, μV ² /Hz	-,064	,012	-65±65	+65±78	+152±143
Active T-Lymphocytes, %	-,052	,053	-1,2±0,7	+0,4±0,6	-0,2±0,7
Fp1-δ SPD, %	-,003	,137	+1,7±5,4	+26,6±16,3	+4,1±4,1
IgA, g/L	,005	,103	-0,03±0,14	+0,40±0,41	-0,01±0,23
Popovych's Adaptation Index, points	,051	,084	+0,16±0,10	+0,49±0,31	-0,01±0,15
Frequency of α-rhythm, Hz	-,011	,074	-0,17±0,23	+0,50±0,34	-0,24±0,06 [#]

F8-β SPD, μV ² /Hz	,013	,033	-11±18	+3±6	-15±12
Fp1-α SPD, %	,055	-,131	+2,0±2,8	-13±9	-3,6±2,5
Entropy of SPD in O1	-,035	-,109	+0,03±0,04	-0,08±0,06	+0,05±0,02 [#]
IgM, g/L	-,020	-,108	+0,10±0,11	-0,25±0,24	+0,12±0,08
Entropy of SPD in F4	,033	-,054	+0,03±0,03	-0,04±0,04	0,00±0,03
Chi Square Tests with Successive Roots Removed			Squared Mahalanobis Distances		
Eigenvalues	8,31	5,02	V-N: 60 (F=4,4; <i>p</i> <10 ⁻³)		
Canonical R	,945	,913	S-N: 61 (F=4,6; <i>p</i> <10 ⁻⁴)		
Wilks' Λ	,018	,166	V-S: 38 (F=7,8; <i>p</i> <10 ⁻⁶)		
χ ²	153	66			
Degree Freedom	54	26			
p-level	<10 ⁻⁶	<10 ⁻⁵			

The localization of the points of a neutral cluster along the axis of the first root in its quasi-zero zone reflects, as a rule, quasi-zero changes of the mentioned parameters, but with many exceptions. On the contrary, along the axis of the second radical, the neutral cluster is distanced very clearly from the other two, which, in turn, are not delimited completely. This reflects the increase in the values of the parameters positively correlated with the second root and the decrease in the values of negatively correlated with its parameters in comparison with quasi-zero changes in both the vagotonic and sympatotonic vegetotropic reactions.

By means of calculating the classifying functions for their coefficients and constants (Table 11) as well as individual values of postprandial changes, the selected discriminant variables allow to identify retrospectively the variant of the vegetotropic reaction to the stimulus without mistakes.

Table 11

Coefficients and Constants for Classification Functions

Variables currently in the model	Vagotonic	Neutral	Sympathotonic
	<i>p</i> ≠,39	<i>p</i> ≠,11	<i>p</i> ≠,50
Baevskiy's Stress Index, ln units	-5,701	9,881	9,438
Triangulary Index, units	1,357	-,422	-,696
T5-α SPD, μV ² /Hz	-,027	,066	,006
T5-β SPD, %	-,207	,273	,212
F7-θ SPD, μV ² /Hz	-,205	,153	,214
Fp1-δ SPD, %	,041	-,078	,130
Frequency of α-rhythm, Hz	-,734	7,082	-,118
Stub Neutrophils, %	,934	-2,896	,373
HF SP, msec ²	,0029	-,0018	-,0087
Popovych's Adaptation Index, points	-6,171	32,98	7,903
Asymmetry of β-rhythm, %	-,096	,232	,034
CD8+CD3+ T cytolytic Lymphocytes, %	-,430	-,212	,695
Entropy of SPD in O1	3,971	-36,92	16,96
Popovych's Strain Index, units	-3,862	16,99	-2,927
Testosterone, nM/L	-,359	1,368	,439
F8-β SPD, μV ² /Hz	,027	-,025	-,031

F4-δ SPD, μV ² /Hz	,0023	,0011	-,0008
F7-α SPD, %	-,109	1,266	-,278
Fp1-α SPD, %	,171	-1,124	,298
T5-α SPD, %	-,045	-,453	,078
LF SP, msec ²	-,0019	,0116	-,0004
IgA, g/L	,086	10,32	-1,224
IgM, g/L	,518	4,780	-3,507
Entropy of SPD in F4	18,89	44,80	-9,331
“Active” T-Lymphocytes, %	-,390	-1,661	,133
Entropy of SPD in P4	-26,87	-20,54	2,054
Index of β-rhythm, %	,0358	,0799	-,0365
Constants	-6,758	-21,97	-6,16

Fig. 2 illustrates the previously mentioned complete absence of differences between the three stimuli within each variant of the vegetotropic response to them. If the similarity of reactions to bioactive waters Naftussya and phytoadaptogen was expected due to the presence of polycyclic hydrocarbons in both stimuli [7, 11, 12, 22, 23], then the vegetotropic activity of ordinary waters caught me by surprise.

Fig. 2. Individual values of first and second roots of vagotonic (V), neutral (N) and sympathotonic (S) vegetotropic reactions to the intake of ordinary waters (W), bioactive waters Naftussya (N) and balsam (B). The volunteers' codes are indicated

The hypothesis should be accepted that the vector of the vegetotropic reaction as well as its absence, is due not to the properties of the stimulus, but to the state of the autonomic reactivity of a person and not at all, especially at the time of using the fluid.

The procedure of the discriminatory analysis of registered initial parameters revealed their constellation (2 of HRV, 21 of EEG and 8 of Immunity as well as Trait anxiety) which allows to predict each of the three variants of the vegetotropic reaction accurately (Table 12).

Table 12

Coefficients and constants for classification of functions and means of predictors of various vegetotropic reaction

Variables-predictors currentlyin the model	Coefficients for reactions			Means of predictors of reaction			Norm levels
	V	N	S	Sympath	Vagotonic	Neutral	
Amplitude of Moda, %	6,54	6,90	7,11	43±3	66±5	55±6	37,8±1,3
C4-θ SPD, %	-36,15	-34,69	-39,25	9,6±0,7	12,8±1,1	11,5±1,8	9,4±0,3
Asymmetry of β-rhythm, %	-11,57	-11,16	-12,61	16±2	24±59	28±10	20±1,5
Entropy of SPD in C4	2476	2357	2512	0,84±0,02	0,89±0,02	0,89±0,03	0,83±0,01
Circulating Immune Comp, un	,95	,93	,96	38±3	74±24	42±4	54±5
C4-δ SPD, %	-12,96	-11,30	-12,52	20,2±2,2	25,1±2,5	21,4±2,3	21,6±1,2
“Active” T-Lymphocytes, %	121	116	127	25,6±0,6	26,6±1,1	26,8±1,5	29,6±0,8
Triangulary Index, units	44,12	43,97	47,85	10,9±0,8	7,4±0,7	7,9±1,1	11,2±0,3
Stub Neutrophils, %	97,97	96,59	104,6	4,30±0,36	2,86±0,37	3,52±0,28	3,50±0,23
Asymmetry of α-rhythm, %	3,80	3,26	3,98	18,4±2,4	14,7±1,1	10,3±0,6	17,0±1,1
Index of β-rhythm, %	-2,89	-2,35	-2,97	92,0±2,8	76,1±6,0	91,3±5,7	87,9±1,8
O1-α SPD, %	5,40	5,01	5,74	48±5	33±5	44±8	48±3
Killing Index of Neutroph, %	10,68	10,01	10,96	38±2	32±4	33±4	40±2
0-Lymphocytes, %	-13,65	-11,81	-14,11	16,2±1,7	14,2±1,2	12,9±4,0	8,0±0,8
Laterality Index of α-rhythm,%	-3,20	-3,51	-3,66	-3±4	+8±4	-14±3	-2±2
Fp1-δ SPD, %	29,80	28,33	31,37	18±3	22±4	11±2	18,9±1,4
Immunoglobulins A, g/L	-37,90	-63,88	-73,40	1,27±0,05	1,40±0,074	1,19±0,15	1,90±0,06
T3-δ SPD, %	-1,66	-1,96	-2,07	21±3	27±4	18±4	20,2±1,4
Frequency of θ-rhythm, Hz	127,6	115,4	130,3	6,4±0,3	6,6±0,2	5,8±0,6	6,5±0,1
F8-δ SPD, μV²/Hz	1,14	1,03	1,20	43±10	82±35	21±6	71±14
P3-θ SPD, %	26,86	24,01	29,41	9,0±0,9	10,0±1,2	7,3±0,9	7,6±0,3
Fp1-δ SPD, μV²/Hz	-2,72	-2,63	-2,82	51±13	87±40	21±5	63±13
F4-δ SPD, μV²/Hz	,22	,19	,31	77±14	150±70	55±14	89±9
T4-δ SPD, μV²/Hz	-,11	-,19	-,54	48±7	80±28	43±10	73±12
F7-δ SPD, μV²/Hz	-,02	-,15	-,15	40±8	60±19	31±8	72±14
T6-δ SPD, μV²/Hz	-3,06	-2,71	-3,08	38±7	59±21	30±8	64±11
Laterality Index of δ-rhythm, %	3,13	2,97	3,32	-7±9	0±8	-16±6	+1±4
Trait anxiety, points	-5,15	-5,31	-6,20	46,9±1,2	48,4±1,5	45,8±3,0	38,0±1,2
Theophill resistance T-Lym, %	3,14	4,10	3,84	22,0±1,2	21,9±0,80	30,0±4,5	33,2±1,2
Eosinophils, %	-28,89	-24,40	-32,21	3,50±0,15	3,33±0,21	4,83±1,14	3,50±0,23
Entropy of SPD in F8	-415	-344	-417	0,78±0,03	0,76±0,05	0,86±0,05	0,76±0,02
Deviation of δ-rhythm, Hz	74,18	68,43	71,30	0,79±0,05	0,76±0,07	0,92±0,15	0,70±0,03
Constants	-3214	-3019	-3407

Fig. 3. Localization in a two-dimensional information space individual values of roots of initial neuroendocrine-immune parameters that determine various vegetotropic reactions

As we can see (Fig. 3) the sympathetic response to the stimulus has developed in the cases of minimum/maximum for a sample of initial values of the parameters associated with the first root. The neutral response is determined by the minimum/maximum values of the parameters associated with the second root, whereas the predictors of the vagotonic reaction are the maximal/minimal of these parameters.

Conclusion. The vector of the vegetotropic reaction as well as its absence is due not to the properties of the stimulus, but to the state of autonomic reactivity of a person, and not at all, especially at the time of using the fluid.

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Compliance with ethical standards. Tests of patients were conducted in accordance with the Declaration of Helsinki (1975), which was revised and complemented in 2002 and the directive of the Science Research Ethics Committee. During the tests the informed consent has been taken from all participants' parents and all necessary measures have been used for providing the anonymity of participants.

Authors state no conflict of interests.

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RESEARCH ARTICLES

Immediate responses of the autonomic nervous system to the balneofactors, their neuro-endocrine-immune accompaniments and predictors*I.L. POPOVYCH**Bohomolets' Institute of Physiology of National Academy of Sciences, Kyiv, Ukraine**email: i.popovych@biph.kiev.ua*

Introduction. In previous studies it has been shown that in response to the intake of Bio-active Water Naftussya (BAWN) the activity of the autonomic nervous system changes and the vector of the reaction is ambiguous. However, the issue of the specificity of immediate effects of BAWN on the nervous as well as endocrine and immune systems is still relevant. This is the objective of this study.

Material and Methods. The object of the observation was 15 volunteers-men (aged 26÷60, M±SD: 44±12 years) without any clinical diagnose but with a moderate dysfunction of neuroendocrine-immune complex (dysadaptation). At the beginning volunteers filled in a questionnaire with the purpose of estimation of the level of the trait anxiety. Then HRV and EEG were recorded. The content of principal adaptation hormones such as Cortisol, Testosterone and Triiodothyronine as well as parameters of Immunity were determined in blood. After registration 5 volunteers of the basic level consumed some days 200 mL of Control Water (distillated, filtered, well), Water Naftussya from layers Truskavets' and Skhidnyts'a while 10 volunteers consumed 5 mL of Phytocomposition 'Balm Cryms'kyi' (it is identified as an adaptogen) soluted in 195 mL of daily Water. all tests were repeated in an hour and a half.

Results. It has been confirmed that the polyvariant nature of the vegetotropic reactions to the balneofactors, namely Bayevskiy's Stress Index has increased in half of the observations, while in 39% it has decreased and only in 11% has not changed significantly. No differences were found between the effects of all applied stimuli. The method of discriminant analysis revealed 27 parameter change which are characteristic of vegetotropic reactions (Bayevskiy's Stress Index, 3 parameters of HRV, 15 of EEG and 7 of Immunity as well as Testosterone). It has been revealed that initial parameters (2 of HRV, 21 of EEG and 8 of Immunity as well as trait anxiety) allowed to predict each of the three variants of the vegetotropic reaction accurately.

Conclusion. The vector of the vegetotropic reaction as well as its absence, is not due to the properties of the stimulus, the time of the use of the balneofactor, but to the state of autonomic reactivity of a person.

Key words: balneofactors, neuroendocrine-immune complex, immediate reactions.