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The influence of the Ukrainian phytocomposition "Balm Truskavets'" on parameters of neuro-endocrine-immune complex and biophotonics in humans with maladaptation

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Abstract

Background. Earlier we showed that the Ukrainian phytocomposition "Balm Truskavets'" exerts immediate modulating effects on parameters of EEG and HRV as well as biophotonics. In a pilot study on 10 volunteers, we found that the use of the phytocomposition for 11 days causes changes in EEGs parameters accompanied by a sympatho(adreno)mimetic effect. The modulating effects on the EEG&HRV parameters are combined with the changes in biophotonics parameters. This study was conducted on a four times larger cohort and with a wider range of methods. **Materials and Methods**. The object of observation were 16 women 46±15 ys and 24 men 50±11 ys. The volunteers were practically healthy, but the initial testing revealed deviations from the norm in a number of parameters of the neuro-endocrine-immune complex as a manifestation of maladaptation. The adaptation hormones levels, Popovych's leukocytary adaptation and strain indices, parameters of phagocytosis, biophotonics, acupuncture points, EEG and HRV, before and after a 9-day course of use of phytocomposition registered. **Results.** A noticeable effect of the phytocomposition on 38 parameters was revealed, grouped into 6 clusters, of which 4 are enhancing and 2 are reducing. In particular, the reduced levels of the adaptation index and phagocytosis parameters increase significantly, instead, the increased levels of the strain index, testosterone, triiodothyronine, LF band HRV as well as two biophotonics parameters decrease, that is, there is a normalizing/beneficial effect. At the same time, normal levels of HRV-markers of vagal tone decrease, and cortisol and circulating catecholamines as well as the activity of β- and α-rhythm generating neurons increase, but within the normal range. Finally, there is a further increase in the upper limit levels of activity of δ-rhythm generating neurons. **Conclusion**. Ukrainian phytocomposition "Balm Truskavets'" exerts classical adaptogenic effects on parameters of neuro-endocrine-immune complex as well as biophotonics and acupuncture in humans with maladaptation.
Keywords: phytocomposition "Balm Truskavets'", neuro-endocrine-immune complex, biophotonics, acupuncture, maladaptation.

INTRODUCTION

Earlier we showed that the Ukrainian phytocomposition "Balm Truskavets'" (ТУ У 15.8-24055046-005:2009, produced by private research-production enterprise "Ukrainian Balms", Mykolaïv, Ukraine; is analogous to the previous "Balm Kryms'kyi" [1,18,25,26,33,42,47]) exerts immediate (in 1,5 hours after use) modulating effects on parameters of EEG and HRV as well as biophotonics (kirlianogram, gas discharge visualization, GDV) [16,55]. This gives grounds for finding out the long-term (course) effects of the phytocomposition on these parameters. In a pilot study on 10 volunteers, we found that the use of the phytocomposition for 11 days causes changes in EEGs parameters accompanied by a sympatho(adreno)mimetic effect. The modulating effects of the balm on the parameters of the central and autonomous nervous systems are combined with the changes in GDVs parameters [17]. This study was conducted on a four times larger cohort and with a wider range of methods, that allow assessing the state of the neuro-endocrine-immune complex as a marker of adaptation [22,34,49,54].

MATERIAL AND RESEARCH METHODS

The object of observation were employees of the clinical sanatorium "Moldova" and PrJSC "Truskavets' Spa": 16 women 33-71 (M±SD: 46±15) years and 24 men 24-69 (50±11) years. The volunteers were considered practically healthy (without a clinical diagnosis), but the initial testing revealed deviations from the norm in a number of parameters of the neuro-endocrine-immune complex (details follow) as a manifestation of maladaptation.

In the morning in basal condition we registered kirlianogram by the method of GDV by the device of "GDV Chamber" ("Biotechprogress", SPb, RF). Program estimates also Energy and Asymmetry of virtual Chakras [32]. Then recorded simultaneosly electrocardiogram (ECG) and electroencephalogram (EEG). ECG recorded during 7 min in II lead to assess the parameters of heart rate variability (HRV) [10,12,24,57]. Used hardware-software complex "CardioLab+HRV" produced by "KhAI-Medica" (Kharkiv, Ukraine). EEG recorded a hardware-software complex "NeuroCom Standard" (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 the earlobes. Two minutes after the eyes had been closed, 25 sec of artifact free EEG data were collected by computer. In addition to the received parameters, we calculated coefficient of Asymmetry (As) and Laterality Index (LI) for power spectral density (PSD) each rhythm using equations [40]:

As, % = 100•(Max – Min)/Min; LI, % = Σ [200•(Right – Left)/(Right + Left)]/8.

We calculated also for HRV and each locus EEG the Entropy (h) of normalized PSD using Popovych's IL [22,55] equations based on classic Shannon's CE [58] equation:

$hHRV = -[PSDHF \cdot \log_2 PSDHF + PSDLF \cdot \log_2 PSDLF + PSDVLF \cdot \log_2 PSDVLF + PSPULF \cdot \log_2 PSDULF]/\log_2 4$;

$hEEG = -[PSD\alpha \cdot \log_2 PSD\alpha + PSD\beta \cdot \log_2 PSD\beta + PSD\theta \cdot \log_2 PSD\theta + PSD\delta \cdot \log_2 PSD\delta]/\log_2 4$.

Electroconductivity (EC) recorded in follow points of acupuncture: Pg(ND), TR(X) and MC(AVL) at Right and Left side. Used complex "Medissa". For each pair, the Laterality Index was calculated according to the already mentioned equation.

In portion of capillary blood counted up Leukocytogram (LCG) (Eosinophils, Stub and Segmentonucleary Neutrophils, Lymphocytes and Monocytes) and calculated its Adaptation Index as well as Strain Index by Popovych IL [22,33]. We remind that the algorithm of quantization of the Popovych's indexes is based on the proposed Garkavi LKh et al [20] ranges of relative content in the leukocytogram of lymphocytes, which determines the type of General Adaptation Reaction of Organism as well as other components of leukocytogram and total leukocyte levels indicating harmonic or disharmonious character of GARO (Table 1).

Table 1. Quantification of General Adaptation Reaction of Organism, first version [22]

Leukocyto-gram Lymphocy-tes level, %	**G**eneral **A**daptation **R**eaction of **O**rganism	Eosinophils and Stub Neutrophils: 1÷6 %; Monocytes: 4÷7 %; Leukocytes: 4÷8 G/l	Eosinophils and Stub Neutrophils: <1; >6; Monocytes: <4; >7; Leukocytes: <4; >8 G/l
<21	Stress	**1,22**	**0,02**
21÷27	Training	**1,46**	**0,74**
28÷33	Quiet Activation	**1,95**	**0,98**
34÷43,5	Heightened Activation	**1,70**	**0,50**
≥44	Superactivation	**0,26**	

Strain Index-1 = $[(Eo/3{,}5-1)^2 + (SN/3{,}5-1)^2 + (Mon/5{,}5-1)^2 + (Leu/6-1)^2]/4$.

Parameters of phagocytic function of neutrophils estimated as described by Kovbasnyuk MM [36,52]. The objects of phagocytosis served daily cultures of Staphylococcus aureus (ATCC N 25423 F49) as typical specimen for Gram-positive Bacteria and Escherichia coli (O55 K59) as typical representative of Gram-negative Bacteria. Take into account the following parameters of Phagocytosis: activity (percentage of neutrophils, in which found microbes - Hamburger's Phagocytic Index PhI), intensity (number of microbes absorbed one phagocytes - Microbial Count MC or Right's Index) and completeness (percentage of dead microbes - Killing Index KI). On the basis of the registered partial parameters of phagocytosis, taking into account the content of neutrophils (N) in 1 L of blood, the integral parameter - the bactericidal capacity of neutrophils - was calculated by the equation:

BCCN (10^9 Bact/L) = N (10^9/L)•PhI (%)•MC (Bact/Phag)•KI (%)•10^{-4}.

At last in portion of venous blood we determined plasma levels of major hormones of adaptation: Cortisol, Testosterone, Aldosterone, Triiodothyronine and Calcitonin by the ELISA with the use of analyzer "RT-2100C" (PRCh) and corresponding sets of reagents from "Алкор Био", XEMA Co, Ltd and DRG International Inc.

After the initial testing patients used 5 ml of Phytocomposition, pre-diluted in 45 ml of boiled tap water, half an hour before meals three times a day for 9 days. The next morning after completing the treatment, retesting was performed.

Reference values are taken from the database of our laboratory (EEG, GDV, Immunity) or instructions (HRV, ELISA).

Results processed using the software package "Statistica 6.4".

RESULTS AND DISCUSSION

According to the algorithm of Truskavetsian Scientific School, at the preparatory stage of data analysis the registered parameters were normalized, which allowed their correct comparison [22,48]. Further, profiles of normalized parameters were created, the levels of which differ significantly before and after Balm treatment, as well as several parameters which according to the following discriminant analysis were still **recognizable**, despite the **insignificant** value of Student's t criterion (Fig. 1).

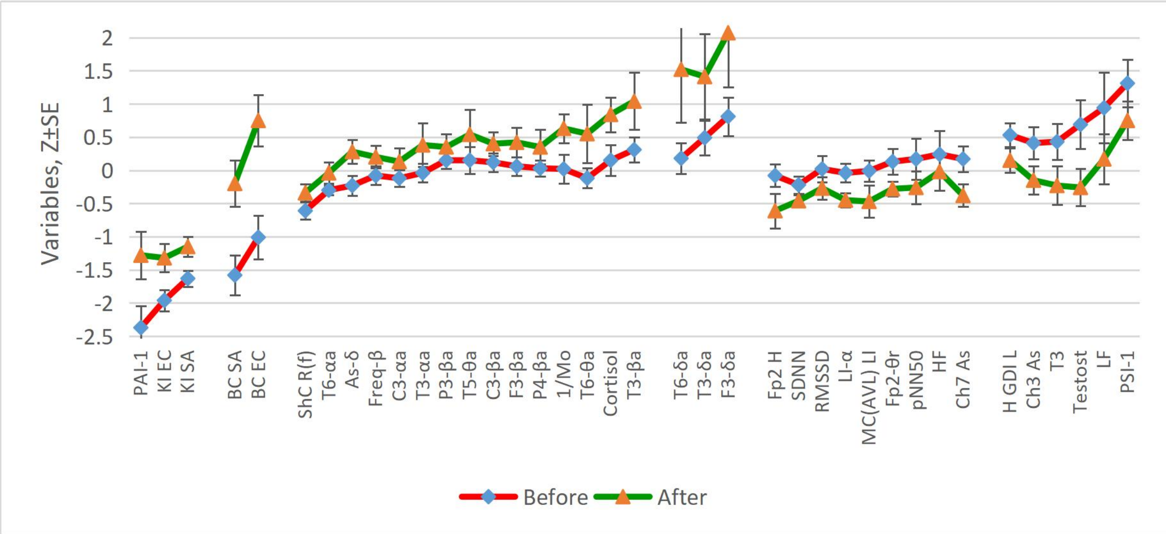

Fig. 1. Profiles of variables whose normalized levels (Z±SE) are changing under the influence of the Phytocomposition

Another approach to quantifying effects is to calculate the direct differences between the final and initial parameters levels of each patient (Fig. 2).

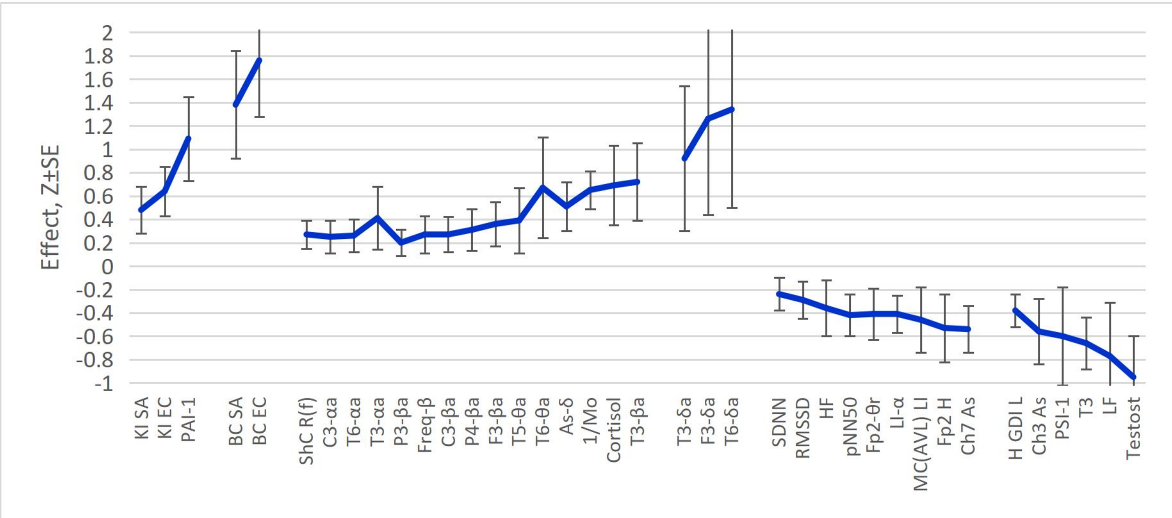

Fig. 2. The effects of the Phytocomposition as direct differences of normalized variables (Z±SE)

Next, 38 parameters were grouped into 6 clusters, of which 4 are enhancing and 2 are reducing (Fig. 3 and Table 8).

In particular, the **reduced** levels of the Popovych's adaptation index and killing indices vs both E. coli and Staph. aureus **increase** significantly, still remaining low (cluster B--/A-).

At the same time, BCCN in relation to gram-positive microbes is completely normalized, and in relation to gram-negative microbes it even reaches the upper zone of the normal range due to the additional slight increase of other elements of this integral parameter of phagocytosis (cluster B-/A0+).

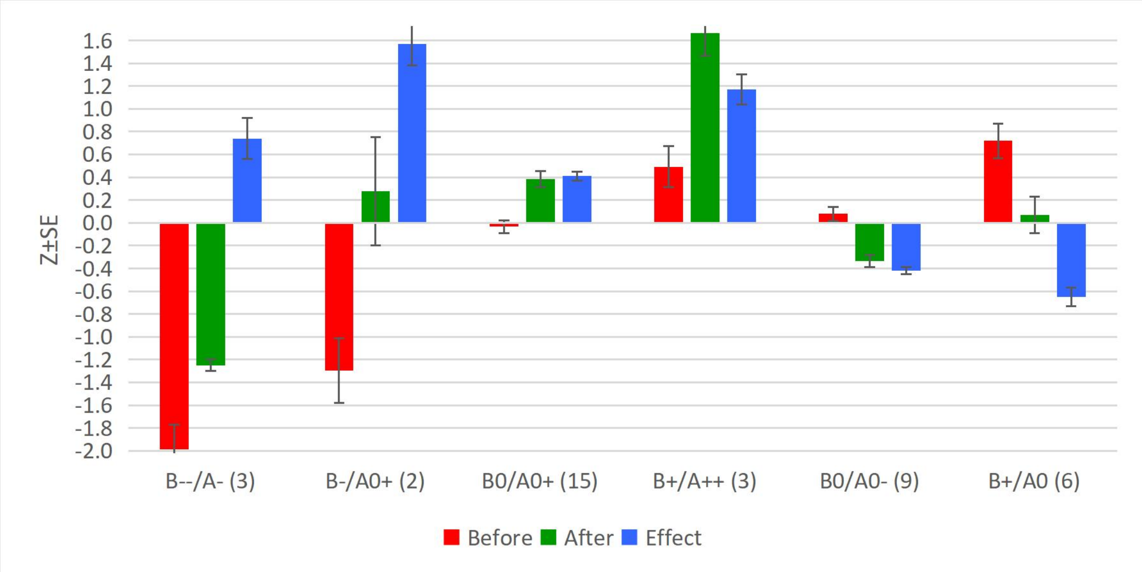

Fig. 3. The clusters of normalized (Z±SE) parameters before (B) and after (A) intake of the Phytocomposition as well as its effects as direct differences (A-B). The number of variables in the cluster is indicated in parentheses

Instead, the **increased** levels of the Popovych's strain index, plasma testosterone and triiodothyronine, LF band of HRV, Entropy of Gas Discharge Image in Left projection (H GDI L) as well as right-sided (positive sign of symmetry index) asymmetry of the virtual third Chakra **decrease** (cluster B+/A0).

That is, there is a **normalizing** (ambivalence-equilibratory) effect as one of the attributes of adaptogens [1,11,18,25,33] according to the good old "law of initial level".

At the same time, **normal** levels of four HRV-markers of vagal tone as well as PSD of θ-rhythm and Entropy in Fp2 locus **also decrease,** albeit slightly. This is accompanied by left lateralization (negative sign of symmetry/lateralization indices) of initially symmetrical (quasi-zero symmetry/lateralization indices) EEG α-rhythm, electrical conductivity of acupuncture points MC(AVL) and virtual seventh Chakra (cluster B0/A0-).

On the other hand, **normal** levels of cortisol and circulating catecholamines (1/Mo as marker) as well as activity of β- and α-rhythm generating neurons **also increase**, albeit slightly. This is accompanied by a rightward shift in the symmetry of δ-rhythm and an increase in Shape Coefficient of GDI in Right projection (SC GDI R) (cluster B0/A0+).

Finally, there is a further increase in the upper limit levels of activity of δ-rhythm generating neurons (cluster B+/A++).

The described changes in parameters of EEG, HRV, hormones and biophotonics are negatively/positively correlated with the changes in parameters of phagocytosis [5,22,36,52] (as well as of immunity [4,6,8,22,35,37,38,51]), so effects of the Phytocomposition are physiologically favorable and therefore adaptogenic.

The previously selected variables were further subjected to discriminant analysis with the aim not so much to discover which of them are formally characteristic, but to visualize the integral state of each volunteer. The forward stepwise program included only 24 variables in the discriminant model, including those subject to non-significant (t<2,02) effects according to the Student criterion (Tables 2-3), while other variables were outside the model, despite significant (*) changes (Tables 4-6). On the face of it, the Wilks' and Student's statistics do not match completely.

Table 2. Discriminant Function Analysis Summary

Step 24, N of vars in model: 24; Grouping: 2 grps; Wilks' Λ: 0,2860; approx. $F_{(24)}$=5,7; $p<10^{-6}$

Variables currently in the model	State (n) and Means±SE			Parameters of Wilks' Statistics					
	Before (40)	After (40)	*Effect (40)*	Wilks' Λ	Par-tial Λ	F-re-move (1,55)	p-level	Tole-rancy	Refer Cv/**SD**
Frequency-β, Hz	17,6 0,6	18,8 0,7	*+1,2* *0,7*	0,398	0,719	21,50	0,000	0,498	17,9 0,244
C3-β PSD, μV²/Hz	102 9	121 13	*+19* *10*	0,382	0,748	18,53	0,000	0,041	93,5 0,733
F3-β PSD, μV²/Hz	82 7	101 12	*+19* *10*	0,353	0,809	12,96	0,001	0,040	79 0,682
P3-β PSD, μV²/Hz	103 8	115 12	*+12* *7*	0,315	0,908	5,55	0,022	0,061	93 0,665
P4-β PSD, μV²/Hz	91 6	108 14	*+17* *10*	0,302	0,946	3,16	0,081	0,058	89 0,611
T3-β PSD, μV²/Hz	94 10	135 24	*+40* *18**	0,292	0,979	1,18	0,281	0,143	77 0,726
Laterality-α, %	-3 5	-17 4	*-14* *5**	0,341	0,839	10,56	0,002	0,430	-1 **34**
T6-α PSD, μV²/Hz	69 10	108 24	*+39* *20*	0,324	0,882	7,34	0,009	0,111	114 1,302
C3-α PSD, μV²/Hz	142 21	183 34	*+42* *24*	0,298	0,959	2,33	0,132	0,129	162 1,039

Asymmetry-δ, %	36,3 3,7	48,7 4,4	*+12,4* *5,0**	0,297	0,963	2,13	0,150	0,603	41,8 0,580
T6-δ PSD, μV²/Hz	89 19	198 66	*+109* *69*	0,310	0,922	4,67	0,035	0,257	74 1,110
F3-δ PSD, μV²/Hz	175 27	296 89	*+121* *78*	0,302	0,948	3,00	0,089	0,292	98 0,981
T5-θ PSD, μV²/Hz	33 5	43 9	*+10* *7*	0,315	0,908	5,60	0,022	0,131	29 0,906
T6-θ PSD, μV²/Hz	21 3	34 9	*+13* *9*	0,290	0,987	0,75	0,390	0,215	23 0,869
SDNN HRV, msec	49,6 4,0	42,6 2,8	*-7,1* *4,0*	0,300	0,954	2,64	0,110	0,570	56,1 0,529
Testosterone normalized, Z	0,69 0,37	-0,26 0,28	*-0,95* *0,35**	0,331	0,865	8,59	0,005	0,671	0 **1**
Chakra 7 Asymmetry	0,08 0,05	-0,05 0,04	*-0,13* *0,05**	0,310	0,922	4,68	0,035	0,518	0,04 **0,24**
Chakra 3 Asymmetry	0,15 0,06	0,02 0,05	*-0,13* *0,06**	0,294	0,973	1,53	0,222	0,590	0,06 **0,23**
Entropy GDI Left	3,83 0,03	3,77 0,03	*-0,05* *0,02**	0,298	0,959	2,38	0,129	0,561	3,75 0,038
Bactericidity vs E. coli, 10⁹ Bacteria/L	89 3	106 4	*+17* *5**	0,286	1,000	0,00	0,980	0,174	99 0,100
Killing Index vs Escherichia. coli, %	43,4 1,5	49,5 2,0	*+6,0* *2,0**	0,317	0,902	5,96	0,018	0,115	62,0 0,156
Bactericidity vs St. aureus, 10⁹ Bact/L	89 3	104 4	*+15* *5**	0,294	0,972	1,57	0,215	0,179	106 0,100
Killing Index vs Staphyloc. aureus, %	45,3 1,0	49,3 1,3	*+4,0* *1,6**	0,286	0,999	0,04	0,843	0,200	58,9 0,142
Popovych's Adapta-tion Index-1, units	1,13 0,08	1,39 0,09	*+0,27* *0,09**	0,419	0,682	25,66	0,000	0,546	1,705 0,245

Notes. In each column, the first line is the average, the second – SE. In norm column - the average and Cv or ***SD***. The "*Effect*" and "*Norm*" columns are not the result of discriminant analysis

Table 3. Summary of stepwise analysis of discriminant variables ranked by criterion Λ

Variables currently in the model	F to enter	p-level	Λ	F-value	p-value
Bactericidity vs E. coli, 10⁹ Bacteria/L	11,6	0,001	0,870	11,6	0,001
Popovych's Adaptation Index-1, units	6,06	0,016	0,807	9,22	0,0003
T6-θ PSD, μV²/Hz	7,74	0,007	0,732	9,27	10^{-4}
Laterality-α, %	4,53	0,037	0,690	8,41	10^{-4}
Killing Index vs E. coli, %	7,09	0,010	0,630	8,69	10^{-5}
Frequency-β, Hz	8,19	0,006	0,567	9,31	10^{-6}
SDNN HRV, msec	5,74	0,019	0,525	9,31	10^{-6}
Testosterone normalized by sex&age, Z	3,37	0,071	0,501	8,84	10^{-6}
Bactericidity vs Staph. aur, 10⁹ Bacteria/L	3,46	0,067	0,477	8,52	10^{-6}
Chakra 7 Asymmetry	1,99	0,163	0,464	7,97	10^{-6}
Killing Index vs Staph. aureus, %	1,58	0,213	0,453	7,45	10^{-6}
Asymmetry-δ, %	2,04	0,158	0,440	7,10	10^{-6}
F3-δ PSD, μV²/Hz	1,53	0,221	0,430	6,73	10^{-6}
T6-α PSD, μV²/Hz	1,16	0,285	0,423	6,34	10^{-6}
T5-θ PSD, μV²/Hz	1,67	0,201	0,412	6,09	10^{-6}
T6-δ PSD, μV²/Hz	1,25	0,267	0,404	5,81	10^{-6}
C3-β PSD, μV²/Hz	1,10	0,298	0,397	5,58	10^{-6}
F3-β PSD, μV²/Hz	9,40	0,003	0,344	6,47	10^{-6}
C3-α PSD, μV²/Hz	3,19	0,079	0,326	6,52	10^{-6}
P3-β PSD, μV²/Hz	1,46	0,232	0,319	6,31	10^{-6}
P4-β PSD, μV²/Hz	1,76	0,189	0,309	6,17	10^{-6}
Entropy of Gas Discharge Image Left	2,06	0,157	0,298	6,09	10^{-6}
Chakra 3 Asymmetry	1,20	0,279	0,292	5,90	10^{-6}
T3-β PSD, μV²/Hz	1,18	0,281	0,286	5,72	10^{-6}

Table 4. EEG variables currently not in the discriminant model

Variables	State (n) and Means±SE			Parameters of Wilks' Statistics					
	Before (40)	After (40)	*Effect (40)*	Wil ks' Λ	Par-tial Λ	F to enter	p-le-vel	Tole-rancy	Refer Cv/**SD**
Fp2 PSD Entropy	0,823 0,020	0,769 0,029	*-0,054* *0,033*	0,285	0,995	0,26	0,614	0,549	0,835 0,135
Fp2-θ PSD, %	10,7 1,2	8,2 0,6	*-2,5* *1,4*	0,284	0,994	0,35	0,556	0,631	9,9 0,620
T3-α PSD, μV²/Hz	86 12	122 29	*+36* *23*	0,286	0,999	0,08	0,780	0,088	89,5 0,972
T3-δ PSD, μV²/Hz	129 23	213 58	*+83* *56*	0,285	0,998	0,11	0,740	0,143	86 1,055

Table 5. HRV variables currently not in the discriminant model

Variables	State (n) and Means±SE			Parameters of Wilks' Statistics					
	Before (40)	After (40)	*Effect (40)*	Wil ks' Λ	Par-tial Λ	F to enter	p-level	Tole-rancy	Refer Cv/**SD**
Mode HRV, msec	871 23	811 23	*-65* *17**	0,285	0,998	0,11	0,738	0,515	874 0,115
RMSSD HRV, msec	29,4 3,1	24,8 2,5	*-4,6* *2,1**	0,286	0,999	0,04	0,851	0,220	29,7 0,482
pNN_{50} HRV, %	10,7 2,5	6,9 1,9	*-3,8* *1,6**	0,286	1,000	0,01	0,927	0,336	9,0 0,846
HF PSD, msec²	500 122	378 93	*-122* *77*	0,286	1,000	0,00	0,952	0,414	363 0,750
LF PSD, msec²	890 152	664 107	*-226* *122*	0,283	0,991	0,48	0,493	0,220	640 0,466

Table 6. Endocrine, Immune and Biophysics variables currently not in the discriminant model

Variables	State (n) and Means±SE			Parameters of Wilks' Statistics					
	Before (40)	After (40)	*Effect (40)*	Wil ks' Λ	Par-tial Λ	F to enter	p-level	Tole-rancy	Refer Cv/**SD**
Triiodothyronine, nM/L	2,41 0,14	2,09 0,15	*-0,33* *0,11**	0,283	0,991	0,49	0,489	0,631	2,20 0,227
Cortisol, nM/L	386 26	464 29	*+78* *38**	0,286	1,000	0,00	0,987	0,496	370 0,303
Popovych's Strain Index-1	0,170 0,019	0,138 0,016	*-0,033* *0,023*	0,286	1,000	0,02	0,880	0,482	0,097 0,559
Shape Coefficient GDI Right (f), un.	13,28 0,22	13,71 0,22	*+0,43* *0,20**	0,284	0,991	0,47	0,498	0,600	14,3 0,114
MC(AVL) EC Laterality, %	-0,03 0,31	-0,88 0,46	*-0,85* *0,54*	0,285	0,997	0,15	0,697	0,747	0,04 **1,91**

On the basis of the raw coefficients and constant (Table 7), the individual values of the canonical discriminant roots were calculated with the following visualization in Fig. 4.

Table 7. Standardized and raw coefficients and constant for discriminant variables

Variables	Coefficients	
	Standar-dized	Raw
Bactericidity vs E. coli, 10^9 Bac/L	0,009	0,0004
Popovych's Adaptation Ind-1, un.	-0,903	-1,695
T6-θ PSD, μV²/Hz	-0,296	-0,007
Laterality-α, %	0,724	0,027
Killing Index vs E. coli, %	-1,091	-0,096
Frequency-β, Hz	-0,889	-0,211
SDNN HRV, msec	0,336	0,015
Testosterone normalized, Z	0,531	0,282
Bactericidity vs St. aur, 10^9 Bac/L	-0,466	-0,021
Chakra 7 Asymmetry	0,461	1,944
Killing Index vs Staph. aureus, %	0,071	0,001
Asymmetry-δ, %	-0,294	-0,011
F3-δ PSD, μV²/Hz	0,498	0,001
T6-α PSD, μV²/Hz	-1,220	-0,010

T5-θ PSD, µV²/Hz	0,995	0,020
T6-δ PSD, µV²/Hz	-0,653	-0,002
C3-β PSD, µV²/Hz	-2,945	-0,042
F3-β PSD, µV²/Hz	2,584	0,042
C3-α PSD, µV²/Hz	0,665	0,004
P3-β PSD, µV²/Hz	1,455	0,022
P4-β PSD, µV²/Hz	-1,148	-0,017
Entropy GDI Left	0,322	2,294
Chakra 3 Asymmetry	0,253	0,893
T3-β PSD, µV²/Hz	-0,455	-0,004
Constant		3,410
Eigenvalue		2,496
Squared Mahalanobis Distance=9,73; $F_{(25)}$=5,7; $p<10^{-6}$		
Canonical R=0,845; Wilks' Λ=0,2860; $\chi^2_{(24)}$=83; $p<10^{-6}$		

As you can see, the level of the root after the course of using the Phytocomposition in all volunteers, without exception, is lower than the initial level to one degree or another. This reflects both increasing levels of variables represented in the root inversely and decreasing levels of variables that are positively correlated with the root (Table 8).

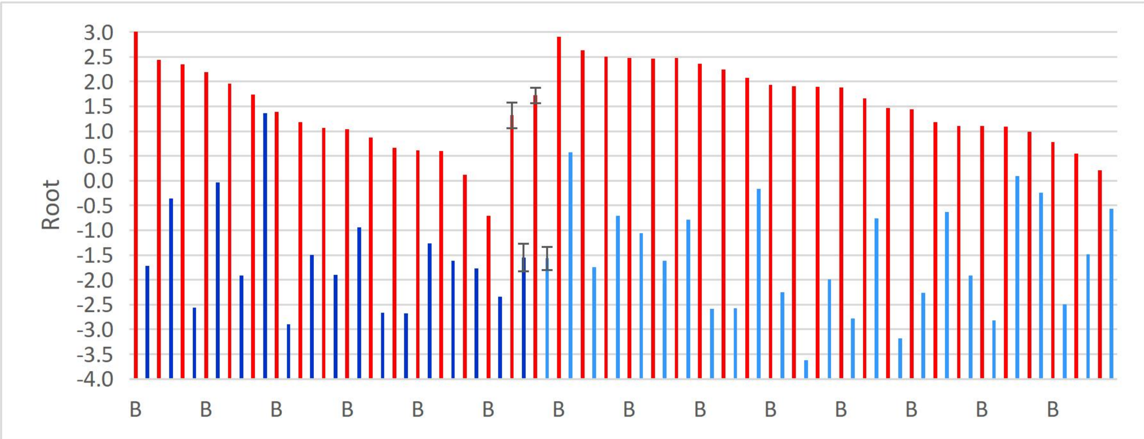

Fig. 4. Individual and average (M±SE) values of discriminant Root at Women and Men before (B) and after course of intake of the Phytocomposition

No sexual dimorphism was found either in the initial or final variables (Fig. 5), as well as in the effects of the phytocomposition. At the same time, there are significant differences in the individual effects of the phytocomposition in both women and men (Fig. 6).

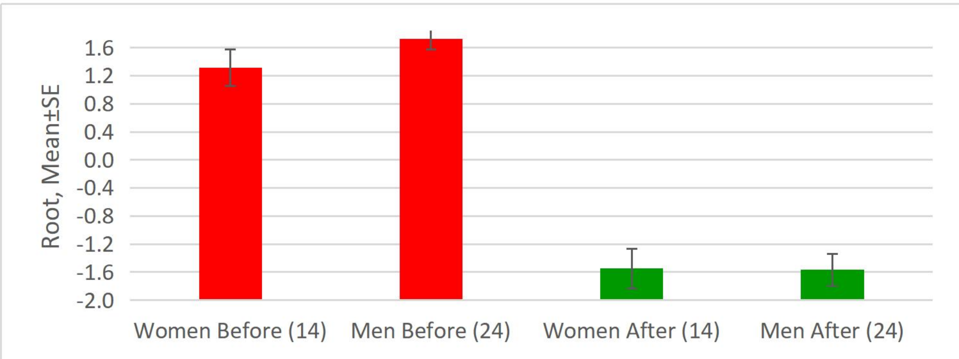

Fig. 5. Average (M±SE) values of discriminant Root at Women and Men before and after course of use of the Phytocomposition

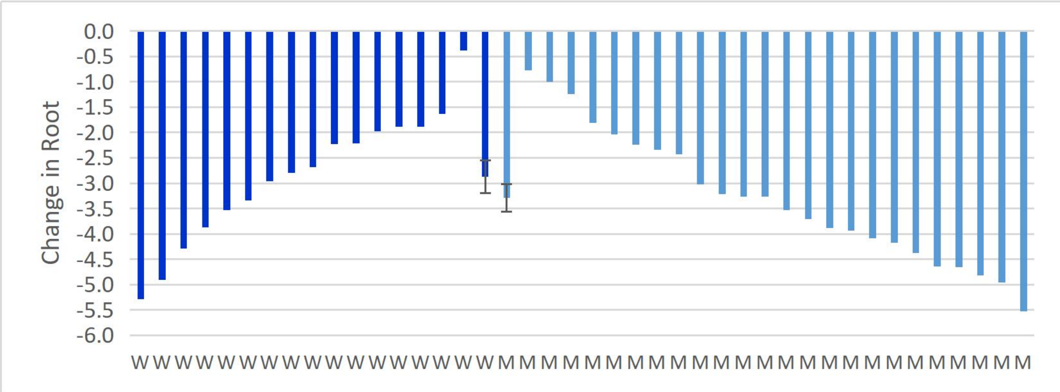

Fig. 6. Individual and average (M±SE) changes in discriminant Root at Women and Men caused by intake of Phytocomposition

Table 8. Clusters of effects as differences between levels (Z±SE) after and before treatment

Clusters and Variables	Structuralco efficient	Before (40)	After (40)	*Effect (30)*
B--/A- (3)		**-1,99±0,21**	**-1,25±0,05**	**+0,74±0,18**
Popovych's Adaptation Index-1	-0,160	-2,37±0,33	-1,28±0,36	+1,09±0,36
Killing Index vs E. coli	-0,171	-1,96±0,16	-1,32±0,21	+0,64±0,21
Killing Index vs Staph. aureus	-0,176	-1,63±0,12	-1,15±0,15	+0,48±0,20
B-/A0+ (2)		**-1,30±0,29**	**+0,28±0,48**	**+1,57±0,19**
Bactericidity vs E. coli	-0,244	-1,01±0,33	+0,75±0,39	+1,76±0,48
Bactericidity vs Staph. aureus	-0,215	-1,58±0,30	-0,20±0,35	+1,38±0,46
B0/A0+ (15)		**-0,03±0,05**	**+0,38±0,07**	**+0,41±0,04**
Asymmetry-δ	-0,147	-0,23±0,15	+0,28±0,18	+0,51±0,21
1/Mode HRV		+0,02±0,22	+0,63±0,22	+0,65±0,16
Cortisol		+0,15±0,23	+0,84±0,26	+0,69±0,34
T6-θ PSDa	-0,103	-0,12±0,15	+0,55±0,44	+0,67±0,43
T5-θ PSDa	-0,066	+0,15±0,20	+0,54±0,37	+0,39±0,28
T3-α PSDa		-0,04±0,14	+0,38±0,33	+0,41±0,27
T6-α PSDa	-0,106	-0,30±0,07	-0,04±0,16	+0,26±0,14
C3-α PSDa	-0,074	-0,12±0,13	+0,13±0,20	+0,25±0,14
T3-β PSDa	-0,111	+0,31±0,19	+1,04±0,43	+0,72±0,33
F3-β PSDa	-0,101	+0,06±0,14	+0,42±0,22	+0,36±0,19
Frequency-β	-0,091	-0,08±0,14	+0,20±0,17	+0,27±0,16
C3-β PSDa	-0,085	+0,12±0,14	+0,40±0,18	+0,27±0,15
P4-β PSDa	-0,078	+0,03±0,12	+0,35±0,26	+0,31±0,18
P3-β PSDa	-0,061	+0,15±0,13	+0,35±0,20	+0,20±0,11
Shape Coefficient GDI Right (f)		-0,61±0,13	-0,34±0,13	+0,27±0,12
B+/A++ (3)		**+0,49±0,18**	**+1,67±0,20**	**+1,17±0,13**
T6-δ PSDa	-0,114	+0,18±0,23	+1,52±0,80	+1,34±0,84
F3-δ PSDa	-0,093	+0,81±0,29	+2,07±0,93	+1,26±0,82
T3-δ PSDa		+0,49±0,26	+1,41±0,64	+0,92±0,62
B0/A0- (9)		**+0,04±0,06**	**-0,36±0,05**	**-0,40±0,03**
Laterality-α	0,167	-0,04±0,14	-0,45±0,11	-0,41±0,16
MC(AVL) EC Laterality		-0,01±0,16	-0,47±0,24	-0,46±0,28
Chakra 7 Asymmetry	0,132	+0,17±0,19	-0,38±0,17	-0,54±0,20
Fp2 PSD Entropy		-0,08±0,17	-0,61±0,26	-0,53±0,29
Fp2-θ PSDa		+0,13±0,14	-0,28±0,11	-0,41±0,22
SDNN HRV	0,104	-0,22±0,13	-0,46±0,09	-0,24±0,14
pNN$_{50}$ HRV		+0,17±0,31	-0,26±0,25	-0,42±0,18
HF HRV PSD		+0,34±0,35	-0,02±0,28	-0,36±0,24
RMSSD HRV		+0,02±0,20	-0,27±0,17	-0,29±0,16
B+/A0 (6)		**+0,72±0,15**	**+0,07±0,16**	**-0,65±0,08**
Testosterone	0,131	+0,75±0,36	-0,32±0,28	-1,07±0,34
Triiodothyronine		+0,43±0,27	-0,23±0,29	-0,66±0,22
LF HRV PSD		+0,94±0,53	+0,17±0,38	-0,77±0,46
Chakra 3 Asymmetry	0,110	+0,41±0,24	-0,15±0,21	-0,56±0,28
Entropy GDI Left	0,093	+0,53±0,18	+0,15±0,18	-0,38±0,14
Popovych's Strain Index-1		+1,35±0,36	+0,75±0,29	-0,60±0,42

The accuracy of the retrospective classification of phytocomposition effects by calculating individual classification functions based on its coefficients and constants (Table 9) is 95% (Table 10).

Table 9. Coefficients and constants of classification functions

State	Before	After
Variables	0,500	0,500
Bactericidity vs E. coli, 10^9 Bact/L	-0,631	-0,632
Popovych's Adaptation Index-1, un.	6,974	12,26
T6-θ PSD, μV²/Hz	0,162	0,184
Laterality-α, %	-0,131	-0,215
Killing Index vs E. coli, %	1,555	1,856
Frequency-β, Hz	-0,093	0,564
SDNN HRV, msec	0,108	0,060
Testosterone normalized, Z	1,579	0,697
Bactericidity vs St. aur, 10^9 Bac/L	0,699	0,766
Chakra 7 Asymmetry	7,788	1,722
Killing Index vs Staph. aureus, %	0,410	0,380
Asymmetry-δ, %	0,591	0,626
F3-δ PSD, μV²/Hz	0,050	0,046
T6-α PSD, μV²/Hz	0,178	0,210
T5-θ PSD, μV²/Hz	0,060	-0,003
T6-δ PSD, μV²/Hz	-0,068	-0,061
C3-β PSD, μV²/Hz	0,097	0,227
F3-β PSD, μV²/Hz	0,075	-0,056
C3-α PSD, μV²/Hz	0,042	0,031
P3-β PSD, μV²/Hz	0,434	0,364
P4-β PSD, μV²/Hz	-0,818	-0,766
Entropy GDI Left	324,3	317,2
Chakra 3 Asymmetry	13,60	10,82
T3-β PSD, μV²/Hz	-0,070	-0,058
Constants	-687,6	-698,3

Table 10. Classification Matrix

	Rows: Observed classifications Columns: Predicted classifications		
Group	Percent Correct	Before p=,50	After p=,50
Before	97,5	39	1
After	92,5	3	37
Total	95,0	42	38

Therefore, the phytocomposition "Balm Truskavets'" increases the resistance of the observed cohort to **bacterial** infection, i.e. corresponds to one of the attributes of adaptogens: the ability to cause a state of non-specifically increased resistance of the body to the influence of adverse environmental factors of a physical, chemical and **biological nature** [1,33,46]. An even stronger proof of the adaptogenic ability of the phytocomposition is an increase in the leukocytary Popovych's **adaptation** index, which reflects the quantitative assessment of qualitative changes in the body's general adaptive reactions, namely, a decrease in the share of pathological and premorbid (disharmonious) reactions and an increase in the share of normal (harmonious) reactions [19,20,33].

To what substances does this phytocomposition owe its adaptogenicity?

The most investigated medicinal herbs for their adaptogenic activity are Eleutherococcus senticosus, Panax ginseng, Withania somnifera, Schisandra chinensis, Rhaponticum carthamoides, Lepidium meyenii, and Rhodiola spp. Salidroside, ginsenosides, andrographolide, methyl jasmonate, cucurbitacin R, dichotosin, and dichotosininare are phytochemicals that have shown a considerable adaptogenic activity. Phytochemicals that have been demonstrated adaptogenic properties mainly belong to phytoecdysteroids, flavonoids, phenolic acids, et al. Phytoecdysteroids - a large class of steroid compounds. Their structures are composed by 27–29 C-atoms, with a four-ring steroid skeleton and contain polyhydroxyl groups (4–7 hydroxyl groups). Flavonoids are substances with a phenolic structure, and over 8000 flavonoids are known. Flavonoids are divided into the subclasses flavonols, flavones, flavanones, catechins, and their glycosides. Phenolic acids: Protocatechuic, Benzoic, Hydroxyphenylacetic, Hydroxybenzoic, Salicylic, Gentisic, Elagic, Chlorogenic, Vanillic, Coumaric, Synapic, Caffeic, Ferulic, Gallic, Syringic [15,59].

Sergeeva I et al [56] give a different classification of phenols. In accordance with the pathways of biosynthesis in plants, phenolic compounds are subdivided into eight groups: compounds of the C6 series, or simple phenols; compounds of the C6-C1 series, or phenolic acids (derivatives of benzoic acid); C6-C2 compounds, or phenolic alcohols and phenylacetic acids; compounds of the C6-C3 series, or hydroxycinnamic acids, phenylpropenes, and coumarins; compounds of the C6-C4 series, or flavonoids or isoflavonoids, as well as lignins and polymeric phenolic compounds—lignin, tannins, and melanins. An important property of phenolic compounds is the ability to oxidize; they are especially easily oxidized in an alkaline environment. Phenolic compounds with two phenolic rings include: flavonoids, catechins, leukoanthocyanins, flavones, and anthocyanidins. Flavonoids differ in the degree of oxidation: the most reduced of them are catechins, the most oxidized are flavonols.

Currently, we do not have data on the chemical composition of the "Balm Truskavets'". In the composition of its predecessor and analogue "Balm Kryms'kyi", polyphenols were detected in the amount of 4 mg/L compared to 7 mg/L in ginseng tincture (produced by

"Lubnykhimfarm", Ukraine) [1]. It is interesting that polyphenols in amounts of 0,039÷0,28 mg/L were also found in the composition of bioactive Naftussya water [18,27,28,61], the adaptogenic properties of which have long been known [19,25,33,54].

The adrenomimetic effect of both "Balm Kryms'kyi" and ginseng tincture on the isolated heart of a frog [1], due to inhibition of catechol-o-methyltransferase activity [39], is associated with polyphenols.

However, we are inclined to the neurogenic mechanism of the adreno-sympathomimetic effect of the phytocomposition revealed in this study. This is consistent with literature data on the direct neurotropic effect of phytoadaptogens in vitro and in vivo [2,43-45], as well as our data on changes in EEG parameters.

The figures presented by Winkelmann T et al [60] give us reason to assume that the loci C3/C4 projected precentral gyrus, T3/T4 – inferior temporal gyrus, F3/F4 - caudal anterior cingulate cortex or rostral middle frontal gyrus, P3/P4 – supramarginal gyrus, T5/T6 – transverse temporal cortex. The **thickness** of these cortical structures is positively correlated with the HF HRV as marker of vagal tone. However, according to our data, an increase in **electrical activity**, or more precisely PSD, of neurons that project to the listed loci is accompanied by a moderate, within the normal range, decrease in vagal tone, as well as plasma levels of testosterone and triiodothyronine in combination with a moderate increase in the levels of cortisol and circulating catecholamines. This is consistent with the concept that adaptogens are **eustress** inducers that prevent the development of **distress** under the influence of pathogenic factors [19,20,33,34,46].

In previous studies of our laboratory, in line with the concept of the neuro-endocrine-immune complex [49], relationships between EEG and HRV [50,53], EEG&HRV and adaptogene hormones [31,48], EEG&HRV and immunity [22,35-38,48,51,52] parameters were tracked in detail.

With regard to the mechanism of the neurotropic action of phytochemicals, in particular polyphenols, we suggest the mediating role of aryl hydrocarbon receptors of neurons [29,30,41]. The possibility of irritation by phytochemicals of the chemoreceptor terminals of the afferent vagal fibers in the intestine with subsequent influence on the activity of CNS neurons should not be rejected [14].

In conclusion, we will discuss the place and role of biophotonics and acupuncture parameters in the adaptogenic effects of the phytocomposition. Previously, it was shown in our laboratory that GDV parameters significantly correlate with parameters of the neuro-endocrine-immune complex [3-6,8,9] and acupuncture points [7] and respond to the influence of another adaptogen - Naftussya bioactive water [23]. Unidirectional changes in the symmetry of the third and seventh Chakras, electrical conductivity of acupuncture points MC(AVL) (represent the immune system) and EEG alpha-rhythm as well as opposite changes in the delta-rhythm were found in this study. According to Ayurveda **third** Chakra associated with **celiac plexus ganglion** and **spleen** as well as [endocrine] pancreas, liver, gall bladder, stomach, duodenum, pancreas; **seventh** Chakra - with **right** (paired EEG loci) and upper brain as well as pineal gland [13]. Therefore, these parameters of biophotonics and acupuncture logically fit into the structure of the anti-inflammatory cholinergic reflex [14].

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ACCORDANCE TO ETHICS STANDARDS

Tests in patients are conducted in accordance with positions of Helsinki Declaration 1975, revised and complemented in 2002, and directive of National Committee on ethics of scientific researches. During realization of tests from all participants the informed consent is got and used all measures for providing of anonymity of participants.

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