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Immediate effects of Ukrainian phytocomposition on biophotonics (GDV), EEG and HRV parameters

Oksana A. Fihura¹, Sofiya V. Ruzhylo¹, Xawery Żukow², Igor L. Popowych³

¹Ivan Franko Pedagogical University, Drohobych, Ukraine

doctor-0701@ukr.net oksanafigura08@gmail.com

²Medical University of Białystok, Białystok, Poland xaweryzukow@gmail.com

³Bohomolets' Institute of Physiology of National Academy of Sciences, Kyiv, Ukraine

i.popowych@biph.kiev.ua

Background. Back in 2015, we registered short-term reactions to the Ukrainian phytocomposition of electroencephalogram and heart rate variability parameters. At the same time, we also recorded the reactions of biophotonics (GDV) parameters, but due to the skepticism of Ukrainian academic science regarding this method, we did not dare to include the results in the article. **Materials and methods.** The object of observation were 12 women (44±13 years) and 62 men (44±12 years) with dysfunction of neuro-endocrine-immune complex. GDV, HRV and EEG parameters were recorded in the morning in basal conditions. Then the members of the main group used 5 ml of phytocomposition dissolved in 45 ml of tap water, instead in the control group used 50 ml of the latter. After 1,5 hours, the test was repeated. **Results.** Discriminant analysis revealed 26 EEG, 6 HRV and 7 GDV parameters characteristic of the initial state and after consumption of phytocomposition or tap water. The use of balm causes the normalizing decrease of increased sympathotonic markers and the increase of decreased vagotonic markers. Physiologically favorable vegetotropic effects of the balm are accompanied by a further increase in the initially increased activity of β -rhythm-generating cortical and subcortical structures as well as activation of θ -rhythm-generating and inhibition of α - and δ -rhythm-generating nuclei whose initial activity was within normal limits. Neurotropic effects are accompanied by a decrease in fractality and entropy and an increase in the area of GDI, as well as the energy of the first, fourth, fifth and seventh chakras (virtual). **Conclusion.** Ukrainian phytocomposition “Balm Truskavets” causes favorable immediate neurotropic and biophysic changes at patients with dysfunction of neuro-endocrine-immune complex.

Keywords: phytocomposition “Balm Truskavets”, GDV, EEG, HRV, immediate effects.

INTRODUCTION

Back in 2015, we registered short-term reactions to the Ukrainian phytocomposition of electroencephalogram and heart rate variability parameters of almost healthy volunteers [50]. At the same time, we also recorded the reactions of biophotonics parameters, but due to the skepticism of Ukrainian academic science regarding this method, we did not dare to include the results in the article. But, as the ancient Romans said, “*tempora mutantur et nos mutamur cum illis*”. After the publication of the article we have been shown that exist strong canonical correlation between parameters of gas discharge visualization (GDV) and principal neuroendocrine factors of adaptation [2] as well as parameters of EEG [3], leukocytogram [6], immunity [4] and phagocytosis [5]. The obtained data gave us irrefutable arguments for a substantive discussion with potential opponents about the relevance of the method.

Recall that the GDV (kirlianography, biophotonics) method is based on the registration of stimulated emission of photons and electrons from the skin surface. Korotkov KG [22-24] believes that GDV method measures the distribution of electron densities in human systems and organs. These electron densities are the main basis of physiological energy, so there is reason to say that the GDV method allows us to measure the body's potential energy reserve. At the same time, the GDV method is a bridge between the logical science of the West and the intuitive science of the East. It allows us to represent the same phenomena in different languages, in different systems, to look at the same things from different points of view.

According to Ayurvedic medicine, Chakras are power centers, related to the endocrine glands and neural plexus as well as to some organs. In Puchko LG [48] we read that the **first** Chakra is related to the testicles and sacral plexus, **second** Chakra to the ovaries, adrenals and kidneys, **third** Chakra to **spleen**, liver and solar plexus, **fourth** Chakra to **thymus**, heart and cardiac plexus, **fifth** Chakra to thyroid and parathyroid glands, **sixth** Chakra to pituitary gland and brain, **seventh** Chakra to pineal gland. Chase CR [10] provides a table according to which the **first** Chakra is associated with adrenals, pelvic nerve plexus, spine, kidneys, bladder, large intestine; **second** Chakra with testes/ovaries, inferior mesenteric ganglion, ileum, organs of reproduction; **third** Chakra with [endocrine] pancreas, celiac plexus ganglion, liver, gall bladder, stomach, duodenum, pancreas, **spleen**; **fourth** Chakra with **thymus**, celiac plexus, heart, circulation, vagus nerve; **fifth** Chakra with thyroid and parathyroid glands, inferior cervical ganglion, lungs, bronchus, larynx, pharynx, large intestine, vagus nerve; **sixth** Chakra with pituitary and pineal glands, thalamus, hypothalamus, superior cervical ganglion, left brain, lower brain, ears/nose, left eye; **seventh** Chakra with pineal gland, right brain, upper brain, right eye.

Korotkov KG [23] put forward the concept that each Chakra is associated with a part of the finger. This approach is embodied in the “GDV Chakras” program, which allows us to quantify the state of *virtual* Chakras.

MATERIAL AND METHODS

The object of observation were 12 women (44±13 years) and 62 men (44±12 years) with dysfunction of neuro-endocrine-immune complex, employees of the clinical sanatoria “Kryshtalevyi Palats” and “Moldova” (Truskavets’, Ukraine). Every of morning before work, carried out initial tests of 6 persons, then the two of them (basic group) used 5 ml of phytocomposition “Balm Truskavets’” (TY Y 15.8-24055046-005:2009, produced by private research and production enterprise “Ukrainian Balms”, Mykolayiv, Ukraine), pre-diluted in 45 ml of boiled tap water. This phytocomposition is analogous to the previous “Balm Kryms’kyi”. The other 4 individuals (control group) used 50 ml of the same water at room temperature (CW).

In the morning on an empty stomach we registered kirlianogram by the method of GDV by the device of “GDV Chamber” (“Biotechprogress”, SPb, RF). The first base parameter of GDV

is **Area** of gas discharge image (GDI) in Right, Frontal and Left projections. The second base parameter is a **Shape coefficient** (ratio of square of length of external contour of GDI toward his Area), which characterizes the measure of serration/fractality of external contour. The third base parameter of GDI is **Entropy**, id est measure of chaos. Program estimates also **Energy** and **Asymmetry** of virtual **Chakras** [22-24].

To assess the parameters of heart rate variability (HRV) recorded during 7 min electrocardiogram in II lead (software and hardware complex "CardioLab+HRV", KhAI-MEDICA, Kharkiv). For further analysis the following parameters HRV were selected. Temporal parameters (Time Domain Methods): the standard deviation of all NN intervals (SDNN), the square root of the mean of the sum of the squares of differences between adjacent NN intervals (RMSSD), the percent of interval differences of successive NN intervals greater than 50 msec (pNN₅₀); Triangular Index (TNN). Spectral parameters (Frequency Domain Methods): power spectral density (PSD) bands of HRV - high-frequency (HF, range 0,40÷0,15 Hz), low-frequency (LF, range 0,15÷0,04 Hz), very low-frequency (VLF, range 0,040÷0,015 Hz) and ultralow-frequency (ULF, range 0,015÷0,003 Hz). Calculated classical indexes: LF/HF; (VLF+LF)/HF; LFnu=100%•LF/(LF+HF) [7,9,14].

After 8-13 minutes, the EEG recorded a hardware-software complex "NeuroCom Standard" (KhAI MEDICA, Kharkiv) 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 lobes of the ears. The duration of the epoch was 25 sec. Among the options considered the average EEG amplitude (μV), average frequency (Hz), frequency deviation (Hz), index (%) as well as absolute (μV²/Hz) and relative (%) PSD of basic rhythms: β (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, calculated coefficient of Asymmetry (As) and Laterality Index (LI) for PSD each Rhythm using formulas [35]:

$$As, \% = 100 \cdot (Max - Min) / Min;$$

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

We calculated also for each locus EEG and HRV Shannon's CE [53] Entropy (h) of normalized PSD using Popovych's [13,50] formulas:

$$h_{EEG} = - [PSD\alpha \cdot \log_2 PSD\alpha + PSD\beta \cdot \log_2 PSD\beta + PSD\theta \cdot \log_2 PSD\theta + PSD\delta \cdot \log_2 PSD\delta] / \log_2 4$$

$$h_{HRV} = - [PSHF \cdot \log_2 PSHF + PSLF \cdot \log_2 PSLF + PSVLF \cdot \log_2 PSVLF + PSULF \cdot \log_2 PSULF] / \log_2 4$$

HRV reference values were taken from the instructions for the "CardioLab+HRV" device, GDV and EEG references were taken from the database of Truskavetsian Scientific School of Balneology.

RESULTS AND DISCUSSION

In order to identify among the registered parameters those whose constellation is three states of persons: initial and after the use of a solution of phytocomposition or control water - differ significantly from each other, discriminant analysis was used [20]. The forward stepwise program included 39 variables in the discriminant model (Tables 1 and 2). Among them, 2 relate to **delta-rhythm**, 4 - **theta-rhythm**, 9 - **alpha-rhythm**, 10 - **beta-rhythm**, 1 - **entropy** of EEG, and the other 6 – HRV, including 2 **sympathetic** and 3 **vagal** markers as well as **entropy** of HRV bands. However, we are most interested in the 7 parameters of **biophotonics**, which confirms their relationship with the parameters of EEG and HRV.

Table 1. Discriminant Function Analysis Summary for GDV, EEGs and HRVs Variables as well as their Reference levels and Coefficients of Variability

Step 39, N of vars in model: 39; Grouping: 3 grps; Wilks' Λ : 0,199; approx. $F_{(78)=3,4}$; $p < 10^{-6}$

Variables currently in the model (n=148)	Groups (n)			Parameters of Wilks' Statistics					Reference Cv/SD
	After Balm (20)	Base-line (74)	After CW (54)	Wilks' Λ	Partial Λ	F-remove (2,1)	p-level	Tolerance	
Area GDI Right, kpixels	29,41 0,68	27,04 0,56	27,02 0,65	0,206	0,968	1,75	0,178	0,060	27,02 0,151
Shape Coefficient GDI Right	14,2 0,5	16,9 0,8	16,9 0,8	0,215	0,925	4,35	0,015	0,054	17,2 0,331
Shape Coefficient GDI Frontal	19,1 1,2	22,1 1,3	23,3 1,5	0,217	0,920	4,63	0,012	0,065	23,4 0,395
Chakra 1 Energy	0,35 0,06	0,23 0,04	0,16 0,06	0,213	0,938	3,56	0,032	0,156	0,20 0,34
Chakra 2 Asymmetry	0,20 0,07	-0,02 0,05	0,21 0,06	0,201	0,989	0,58	0,561	0,431	0,22 0,38
Chakra 5 Energy	0,27 0,07	0,11 0,03	0,13 0,04	0,215	0,925	4,33	0,016	0,316	0,12 0,23
Chakra 7 Energy	0,13 0,06	0,03 0,03	-0,01 0,04	0,203	0,980	1,07	0,346	0,192	0,04 0,26
ULF/TP HRV, %	2,3 0,7	6,8 0,8	10,4 1,2	0,230	0,867	8,24	10^{-3}	0,337	4,6 0,674
LF/HF HRV	3,45 0,85	4,04 0,33	5,21 0,41	0,201	0,990	0,53	0,593	0,288	2,80 0,714
HF HRV PSD, msec²	468 174	291 61	145 15	0,200	0,996	0,20	0,818	0,064	452 0,768
RMSSD HRV, msec	26,4 4,2	23,5 1,5	19,2 1,0	0,214	0,929	4,08	0,020	0,091	37,0 0,459
pNN₅₀ HRV, %	8,3 3,7	5,4 1,2	2,6 0,4	0,205	0,973	1,48	0,233	0,037	9,0 0,858
P4-δ PSD, %	14,3 1,7	20,2 1,3	19,4 1,6	0,223	0,892	6,45	0,002	0,186	27,1 0,671
P4-δ PSD, $\mu V^2/Hz$	47 8	79 9	95 11	0,229	0,871	7,92	0,001	0,152	107 0,886
Asymmetry-θ, %	28,6 3,7	23,0 2,1	18,1 1,8	0,204	0,975	1,37	0,258	0,467	23,0 0,699
O1-θ PSD, %	9,0 1,3	6,6 0,5	6,0 0,5	0,204	0,977	1,28	0,283	0,182	6,7 0,636
O1-θ PSD, $\mu V^2/Hz$	24 4	36 5	38 5	0,203	0,983	0,91	0,405	0,227	36 1,213
O2-θ PSD, %	7,1 1,0	5,2 0,3	5,0 0,4	0,202 593	0,984	0,89	0,412	0,491	6,0 0,603
Fp1-α PSD, %	27,1 2,5	37,7 2,3	39,7 2,7	0,206	0,966	1,91	0,153	0,089	37,2 0,501
F3-α PSD, %	24,2 2,2	35,7 2,2	41,4 2,3	0,206	0,966	1,89	0,156	0,038	34,5 0,547
F3-α PSD, $\mu V^2/Hz$	85 11	156 20	183 24	0,220	0,904	5,69	0,004	0,057	146 1,071
T3-α PSD, %	24,0 2,0	31,6 1,9	36,2 2,0	0,205	0,972	1,54	0,219	0,064	30,7 0,546
T3-α PSD, $\mu V^2/Hz$	62 8	104 13	119 15	0,205	0,970	1,66	0,196	0,107	97 0,988
C3-α PSD,	26,4	35,4	42,4	0,214	0,932	3,89	0,023	0,043	35,3

%	2,2	2,1	2,3						0,510
T6-α PSD, %	23,5 2,7	33,6 2,4	37,3 2,9	0,207	0,962	2,09	0,128	0,095	32,2 0,623
O2-α PSD, %	38,6 4,4	45,5 3,0	50,1 3,5	0,203	0,982	0,98	0,377	0,071	44,6 0,532
O2-α PSD, $\mu\text{V}^2/\text{Hz}$	229 84	463 79	697 128	0,225	0,884	7,03	0,001	0,104	410 1,627
Frequency-β, %	17,2 0,8	19,6 0,5	20,0 0,5	0,215	0,929	4,11	0,019	0,570	19,0 0,200
Asymmetry-β, %	21,7 4,3	23,9 2,1	17,6 2,8	0,211	0,945	3,11	0,049	0,610	20,1 0,699
F3-β PSD, $\mu\text{V}^2/\text{Hz}$	108 10	83 7	69 6	0,208	0,960	2,22	0,113	0,128	78 0,667
T4-β PSD, %	42,5 4,3	36,7 2,1	30,6 2,3	0,212	0,938	3,55	0,032	0,088	27,9 0,591
C4-β PSD, %	38,9 3,2	30,9 1,8	25,8 2,1	0,210	0,951	2,76	0,068	0,098	26,3 0,493
C4-β PSD, $\mu\text{V}^2/\text{Hz}$	122 12	89 7	71 5	0,228	0,874	7,69	0,001	0,072	84 0,671
T4-β PSD, $\mu\text{V}^2/\text{Hz}$	99 10	88 10	64 4	0,232	0,859	8,81	10 ⁻³	0,177	72 0,745
T6-β PSD, %	49 5	40 2	26 3	0,214	0,931	3,96	0,022	0,098	30 0,646
P3-β PSD, %	41,6 3,7	30,2 1,8	26,8 2,1	0,209	0,951	2,73	0,070	0,100	25,0 0,549
O1-β PSD, %	42,3 4,7	36,1 2,5	31,1 2,9	0,205	0,973	1,48	0,233	0,106	26,7 0,656
Entropy PSD HRV	0,728 0,025	0,766 0,012	0,785 0,013	0,205	0,970	1,63	0,201	0,273	0,825 0,114
Entropy EEG PSD in O1	0,798 0,036	0,718 0,021	0,709 0,023	0,207	0,961	2,17	0,119	0,190	0,738 0,245

Note. For groups the average values and standard errors are specified; for the norm - the average values and coefficients of variation (Cv) or standard deviations (SD).

Table 2. Summary of Stepwise Analysis for GDV, EEGs and HRVs Variables. The variables are ranked by criterion Lambda

Variables currently in the model	F to enter	p-level	Λ	F-value	p-level
ULF/TP, %	10,8	10 ⁻⁴	0,871	10,8	10 ⁻⁴
F3-α PSD, %	8,05	0,0005	0,783	9,36	10 ⁻⁶
P4-δ PSD, %	9,22	0,0002	0,694	9,56	10 ⁻⁶
C4-β PSD, $\mu\text{V}^2/\text{Hz}$	5,79	0,0038	0,641	8,83	10 ⁻⁶
Chakra 2 Asymmetry	4,52	0,0125	0,603	8,12	10 ⁻⁶
T4-β PSD, $\mu\text{V}^2/\text{Hz}$	4,87	0,0090	0,564	7,75	10 ⁻⁶
Fp1-α PSD, %	3,71	0,0270	0,535	7,29	10 ⁻⁶
P4-δ PSD, $\mu\text{V}^2/\text{Hz}$	3,22	0,0431	0,511	6,88	10 ⁻⁶
LF/HF	3,01	0,0527	0,490	6,53	10 ⁻⁶
Asymmetry-β, %	3,27	0,0409	0,467	6,30	10 ⁻⁶
O2-θ PSD, %	3,12	0,0474	0,447	6,09	10 ⁻⁶
Frequency-β, %	2,56	0,0810	0,430	5,86	10 ⁻⁶
O1-θ PSD, $\mu\text{V}^2/\text{Hz}$	1,72	0,1830	0,419	5,57	10 ⁻⁶
C3-α PSD, %	1,77	0,1738	0,408	5,33	10 ⁻⁶

Chakra 5 Energy	1,64	0,1970	0,398	5,10	10 ⁻⁶
T6- α PSD, %	2,16	0,1196	0,385	4,96	10 ⁻⁶
C4- β PSD, %	2,72	0,0698	0,370	4,89	10 ⁻⁶
P3- β PSD, %	2,33	0,1016	0,357	4,79	10 ⁻⁶
Entropy HRV	2,73	0,0694	0,342	4,74	10 ⁻⁶
HF HRV PSD, msec ²	1,87	0,1587	0,332	4,63	10 ⁻⁶
Chakra 1 Energy	1,83	0,1640	0,323	4,52	10 ⁻⁶
T3- α PSD, μ V ² /Hz	1,64	0,1981	0,315	4,41	10 ⁻⁶
F3- α PSD, μ V ² /Hz	1,75	0,179	0,306	4,32	10 ⁻⁶
O2- α PSD, μ V ² /Hz	1,73	0,1816	0,297	4,24	10 ⁻⁶
O2- α PSD, %	1,86	0,1607	0,289	4,17	10 ⁻⁶
T6- β PSD, %	1,89	0,1560	0,280	4,11	10 ⁻⁶
T4- β PSD, %	2,33	0,1018	0,269	4,09	10 ⁻⁶
RMSSD HRV, msec	1,15	0,3192	0,264	3,99	10 ⁻⁶
pNN ₅₀ HRV, %	1,37	0,2589	0,258	3,91	10 ⁻⁶
F3- β PSD, μ V ² /Hz	1,19	0,3067	0,253	3,82	10 ⁻⁶
Asymmetry- θ , %	1,28	0,2808	0,247	3,75	10 ⁻⁶
Shape Coef GDI Right	1,46	0,2373	0,241	3,69	10 ⁻⁶
Shape Coe GDI Frontal	2,92	0,0578	0,229	3,73	10 ⁻⁶
O1- β PSD, %	1,42	0,2449	0,224	3,67	10 ⁻⁶
Area GDI Right, pixels	1,36	0,2617	0,218	3,62	10 ⁻⁶
T3- α PSD, %	1,46	0,2372	0,213	3,57	10 ⁻⁶
Entropy EEG O1	1,16	0,3180	0,208	3,51	10 ⁻⁶
O1- θ PSD, %	1,32	0,2717	0,203	3,46	10 ⁻⁶
Chakra 7 Energy	1,07	0,3457	0,199	3,40	10 ⁻⁶

In addition, a number of other GDV, EEG and HRV parameters that were not included in the model are noteworthy (Table 3).

Table 3. Discriminant Function Analysis Summary for GDV, EEG and HRV Variables currently not in the model

Variables	Groups (n)			Parameters of Wilks' Statistics					Reference Cv/ SD
	After Balm (20)	Base- line (74)	After CW (54)	Wilks' Λ	Par- tial Λ	F to enter	p- level	Tole- rancy	
Entropy GDI Right	3,75 0,04	3,86 0,03	3,88 0,03	0,199	0,998	0,09	0,911	0,333	3,86 0,052
Chakra 3 Asymmetry	0,37 0,10	0,18 0,05	0,25 0,06	0,199	0,994	0,19	0,894	0,333	0,22 0,38
Chakra 4 Energy	0,51 0,03	0,39 0,04	0,34 0,06	0,196	0,982	0,97	0,382	0,277	0,40 0,28
LFnu, %	64,7 4,8	72,9 1,9	79,5 1,5	0,198	0,993	0,38	0,683	0,165	61,8 0,247
HF/TP, %	20,9 3,9	14,0 1,3	9,3 0,5	0,199	0,996	0,20	0,820	0,151	17,1 1,230
Frequency- δ , Hz	1,08 0,04	1,09 0,02	1,03 0,02	0,199	0,997	0,15	0,860	0,596	1,07 0,165
Deviation- θ , Hz	1,25 0,14	1,11 0,08	0,94 0,08	0,199	0,999	0,03	0,973	0,701	1,00 0,616
Amplitude- α , μ V	13,9 1,9	17,8 1,5	20,9 2,1	0,197	0,988	0,63	0,536	0,030	17,7 0,703
Index α , %	34,1 6,2	42,9 4,0	47,7 4,4	0,197	0,988	0,65	0,526	0,193	48,4 0,558
Fp1- α PSD,	63	120	140	0,197	0,986	0,73	0,483	0,025	109

$\mu V^2/Hz$	9	15	18						1,063
Fp2-α PSD, %	27,5 2,4	35,3 2,2	37,3 2,5	0,199	1,000	0,01	0,991	0,188	33,2 0,535
F4-α PSD, %	25,8 2,2	34,7 2,2	41,7 2,4	0,199	0,997	0,18	0,833	0,073	32,7 0,564
F4-β PSD, %	32,4 3,5	29,9 1,9	25,2 1,9	0,199	0,998	0,08	0,920	0,158	24,5 0,544
F7-α PSD, $\mu V^2/Hz$	97 3	56 8	63 9	0,198	0,994	0,30	0,744	0,149	59 1,410
T6-α PSD, $\mu V^2/Hz$	49 6	102 15	124 18	0,196	0,983	0,93	0,399	0,147	100 1,397
O1-α PSD, %	32,7 3,1	40,7 3,0	46,3 3,4	0,199	0,998	0,11	0,894	0,059	39,9 0,591
Entropy EEG PSD in O2	0,760 0,029	0,688 0,018	0,666 0,022	0,199	0,996	0,19	0,827	0,141	0,727 0,242

Next, the 39-dimensional space of discriminant variables transforms into 2-dimensional space of canonical roots. The canonical correlation coefficient is for Root 1 0,770 (Wilks' $\Lambda=0,223$; $\chi^2_{(68)}=193$; $p<10^{-6}$), for Root 2 0,673 (Wilks' $\Lambda=0,547$; $\chi^2_{(33)}=78$; $p<10^{-4}$). The major root contains 63,7% of discriminative opportunities, the minor - 36,3%.

Table 4 presents raw (actual) and standardized (normalized) coefficients for discriminant variables. The calculation of the discriminant root values for each person as the sum of the products of raw coefficients to the individual values of discriminant variables together with the constant enables the visualization of each person in the information space of the roots.

Table 4. Standardized and Raw Coefficients and Constants for Canonical GDV, EEGs and HRVs Variables

Coefficients Variables	Standardized		Raw	
	Root 1	Root 2	Root 1	Root 2
ULF/TP, %	0,650	-0,546	0,094	-0,079
F3-α PSD, %	0,656	0,808	0,038	0,047
P4-δ PSD, %	0,798	0,629	0,071	0,056
C4-β PSD, $\mu V^2/Hz$	-1,492	-0,976	-0,030	-0,020
Ch2 Asymmetry	-0,079	-0,163	-0,286	-0,587
T4-β PSD, $\mu V^2/Hz$	0,789	0,931	0,012	0,014
Fp1-α PSD, %	-0,124	0,331	-0,007	0,020
P4-δ PSD, $\mu V^2/Hz$	-0,226	-0,239	-0,079	-0,084
LF/HF	-0,032	-0,283	-0,011	-0,093
Asymmetry-β, %	-0,124	-1,185	-0,002	-0,016
O2-θ PSD, %	0,413	0,109	0,108	0,029
Frequency-β, %	0,181	0,435	0,005	0,011
O1-θ PSD, $\mu V^2/Hz$	-0,197	-2,245	-0,012	-0,132
C3-α PSD, %	0,819	-0,099	0,054	-0,007
Ch5 Energy	-0,779	-0,167	-0,049	-0,011
T6-α PSD, %	-0,416	-0,071	-4,057	-0,689
C4-β PSD, %	-0,320	-0,585	-1,789	-3,271
P3-β PSD, %	0,693	-0,007	0,035	-0,0004
Entropy HRV	0,523	-0,298	0,001	-0,0006
HF, msec²	0,644	0,157	0,006	0,002
Ch1 Energy	-0,431	1,482	-0,003	0,009
T3-α PSD, $\mu V^2/Hz$	0,022	-1,540	0,00003	-0,0020
F3-α PSD, $\mu V^2/Hz$	-0,183	1,319	-0,007	0,053
O2-α PSD, $\mu V^2/Hz$	-0,550	-1,358	-0,026	-0,064

O2- α PSD, %	0,602	0,964	0,034	0,054
T6- β PSD, %	0,508	-0,522	2,933	-3,018
T4- β PSD, %	-0,483	0,346	-0,115	0,082
RMSSD, msec	-0,402	0,581	-0,033	0,048
pNN ₅₀ , %	-0,039	0,803	-0,158	3,243
F3- β PSD, μ V ² /Hz	-0,021	1,524	-0,005	0,373
Asymmetry- θ , %	-0,509	-1,172	-0,076	-0,175
Shape C Right	-0,884	-0,257	-0,0003	-0,00008
Shape C Frontal	-0,032	0,289	-0,002	0,018
O1- β PSD, %	0,367	-0,104	1,958	-0,552
Area GDI R, pixels	0,650	-0,546	0,094	-0,079
T3- α PSD, %	0,656	0,808	0,038	0,047
Entropy O1	0,798	0,629	0,071	0,056
O1- θ PSD, %	-1,492	-0,976	-0,030	-0,020
Ch7 Energy	-0,079	-0,163	-0,286	-0,587
	Constants		8,033	2,886
	Eigenvalues		1,457	0,829
Cumulative Proportion			0,637	1

Table 5 presents the full structural coefficients, that is, the coefficients of correlation between the discriminant root and variables. The structural coefficient shows what is the proportion of information about the root contained in this variable. There are also average values (centroids) of Roots and Z-scores of Variables. We consider it expedient to include in the table also out-of-model variables in view of their recognizability.

Table 5. Factor Structure Matrix and Means of Roots and Variables

Variables, Z	Correlations Variables-Roots		After Balm (20)	Base- line (74)	After CW (54)
	R1	R2			
Root 1 (63,8%)					
ULF/TP, %	0,281	-0,200	-0,73	+0,70	+1,88
LF/HF	0,128	0,166	+0,33	+0,62	+1,20
LFnu, %			+0,19	+0,73	+1,16
F3- α PSD, %	0,250	-0,104	-0,55	+0,06	+0,36
C3- α PSD, %	0,228	-0,154	-0,50	0,00	+0,39
T6- α PSD, %	0,177	-0,048	-0,43	+0,07	+0,25
F3- α PSD, μ V ² /Hz	0,155	-0,045	-0,39	+0,06	+0,24
O2- α PSD, μ V ² /Hz	0,146	-0,121	-0,27	+0,08	+0,43
O2- α PSD, %	0,113	-0,065	-0,25	+0,04	+0,23
T3- α PSD, %			-0,40	+0,05	+0,33
Fp1- α PSD, μ V ² /Hz			-0,39	+0,10	+0,27
F4- α PSD, %			-0,38	+0,11	+0,49
O1- α PSD, %			-0,31	+0,03	+0,27
Amplitude- α , μ V			-0,31	+0,01	+0,26
Frequency- β , Hz	0,194	-0,010	-0,46	+0,15	+0,27
T3- α PSD, μ V ² /Hz	0,140	-0,033	-0,36	+0,08	+0,22
Fp1- α PSD, %			-0,54	+0,08	+0,14
F7- α PSD, μ V ² /Hz			-0,38	-0,04	+0,05
T6- α PSD, μ V ² /Hz			-0,36	+0,02	+0,17
Fp2- α PSD, %			-0,32	+0,12	+0,23
Index α , %			-0,53	-0,20	-0,03
O1- θ PSD, μ V ² /Hz	0,095	0,005	-0,26	+0,02	+0,05
Shape C GDI Right	0,136	0,031	-0,52	-0,06	-0,05

Shape C GDI Frontal	0,111	-0,019	-0,46	-0,14	-0,01
Entropy GDI Right			-0,50	+0,06	+0,15
P4-δ PSD, $\mu\text{V}^2/\text{Hz}$	0,162	-0,067	-0,64	-0,30	-0,13
P4-δ PSD, %	0,133	0,074	-0,71	-0,38	-0,43
Entropy HRV	0,140	-0,056	-1,03	-0,62	-0,43
C4-β PSD, $\mu\text{V}^2/\text{Hz}$	-0,262	0,122	+0,69	+0,09	-0,23
F3-β PSD, $\mu\text{V}^2/\text{Hz}$			+0,56	+0,08	-0,19
O2-θ PSD, %	-0,200	-0,015	+0,30	-0,23	-0,28
O1-θ PSD, %	-0,185	0,024	+0,52	-0,03	-0,17
Asymmetry-θ, %	-0,153	0,116	+0,35	0,00	-0,30
Deviation-θ, Hz			+0,39	+0,16	-0,10
Area GDI Right	-0,170	-0,023	+0,59	+0,01	0,00
Chakra 5 Energy	-0,166	-0,094	+0,65	-0,05	0,04
Chakra 7 Energy	-0,145	0,033	+0,35	-0,05	-0,20
Chakra 1 Energy	-0,132	0,046	+0,43	+0,08	-0,13
Chakra 4 Energy			+0,40	-0,02	-0,22
Entropy EEG O1	-0,139	-0,009	+0,33	-0,11	-0,16
Entropy EEG O2			+0,19	-0,22	-0,34
P3-β PSD, %	-0,243	0,048	+1,21	+0,38	+0,13
C4-β PSD, %	-0,215	0,120	+0,97	+0,36	-0,04
T6-β PSD, %	-0,161	0,064	+0,98	+0,51	+0,29
T4-β PSD, %	-0,157	0,135	+0,89	+0,54	+0,16
T4-β PSD, $\mu\text{V}^2/\text{Hz}$	-0,121	0,120	+0,51	+0,30	-0,16
F4-β PSD, %			+0,73	+0,41	+0,05
O1-β PSD, %			+0,94	+0,53	+0,25
HF, msec²	-0,164	0,116	+0,04	-0,46	-0,88
RMSSD, msec	-0,136	0,152	-0,63	-0,79	-1,05
HF/TP, %			+0,18	-0,15	-0,37
pNN₅₀, %			-0,06	-0,47	-0,83
Root 2 (36,3%)	R1	R2	-0,45	+0,88	-1,04
Chakra 2 Asymmetry	-0,086	-0,232	+0,28	-0,39	+0,31
Chakra 3 Asymmetry			+0,40	-0,10	+0,07
Asymmetry-β, %	-0,036	0,185	+0,11	+0,27	-0,18
Frequency-δ, Hz			+0,02	+0,13	-0,25

As a preamble, we present existing views on the interpretation of HRV parameters. Well-known markers of Vagal tone are HF, RMSSD and pNN₅₀. LFnu is admitted HRV marker of Sympathetic tone, LF/HF ratio reflects the sympathetic-vagal balance. It is speculated that absolute PSD LF band reflects mainly Sympathetic outflow or both Sympathetic and Vagal origin [7,9,14,52]. The interpretation of the other two bands remains the most controversial. VLF band (0,040÷0,0033 Hz) associated with oscillation blood levels of renin (0,04 Hz) and epinephrine (0,025 Hz), reflects thermoregulatory cycles, endothelial influences, cerebral ergotropic and metabolotropic outflows, activation of cerebral sympatho-adrenal system, sympathetic and vagal activity [7,18,19,21,25,52]. ULF band (<0,0033 Hz) associated with oscillation blood level of norepinephrine (0,0020 Hz) as well as 17-OCS (0,0019 Hz) [cit by: 25]. Because in our device ULF band (range 0,015÷0,003 Hz) is integrated into the lower zone of VLF band, what has been said about the latter also applies to the former.

The above gives grounds to state in our contingent a sympathotonic shift of the autonomic balance due to both an increase in **sympathetic** tone and a decrease in **vagal** tone. There may be elevated levels of norepinephrine and glucocorticoids in the blood. This is accompanied by **increased** activity of beta-rhythm-generating cortical and subcortical structures that are

designed on the right (paired) loci C4, T4, T6 and F4 as well as left loci P3 and O1. The right-hand shift of beta-rhythm symmetry is documented by a positive value of the asymmetry index. Interestingly, the symmetry of **Chakra 2** and, to a lesser extent, **Chakra 3** is shifted to the left.

It is traditionally believed that loci C3/C4 projected hippocampus, loci T3/T4 reflect the activity of the amygdala [49]. In practice, transcranial magnetic and direct current stimulation of the T3/T4 scalp position is used to reach the insular cortex, and F3/F4 loci - to activate the dorsolateral prefrontal cortex nuclei [review: 16]. The figures presented by Winkelmann T et al [54] and Yoo HJ et al [55] 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 or superior frontal gyrus, P3/P4 – supramarginal gyrus, T5/T6 – caudal anterior cingulate cortex. These cortical structures affect the activity of the vagus and sympathetic nuclei.

Figures 1 and 2 show that the use of balm causes a shift in the information field of the discriminant roots of the GDV, HRV and EEG parameters to the left and up. The shift to the left reflects, first of all, the normalizing decrease of increased sympathotonic markers and the increase of decreased vagotonic markers.

This is in line with the concept we put forward back in 1993 about ambivalence-equilibratory character of influence on organism of human of curative water Naftussya [8], which is now considered a generally accepted adaptogen [1,11,12,15,26,28,46,47,51].

Physiologically favorable vegetotropic effects of the balm are accompanied by a further increase in the initially increased activity of **beta-rhythm**-generating cortical and subcortical structures as well as activation of **theta-rhythm**-generating and inhibition of **alpha**- and **delta**-rhythm-generating nuclei whose initial activity was within normal limits.

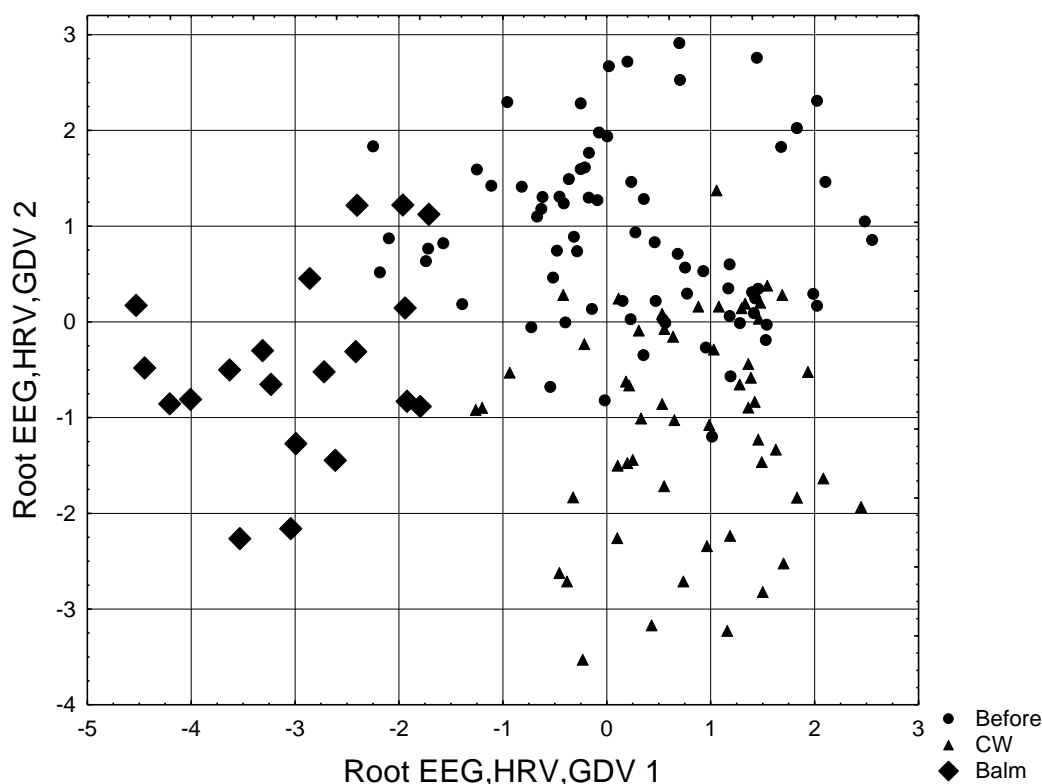


Fig. 1. Individual values of the first and second the GDV, EEG and HRV roots of the patients before (Baseline) and 1,5 hours after application of Control Water or Balm

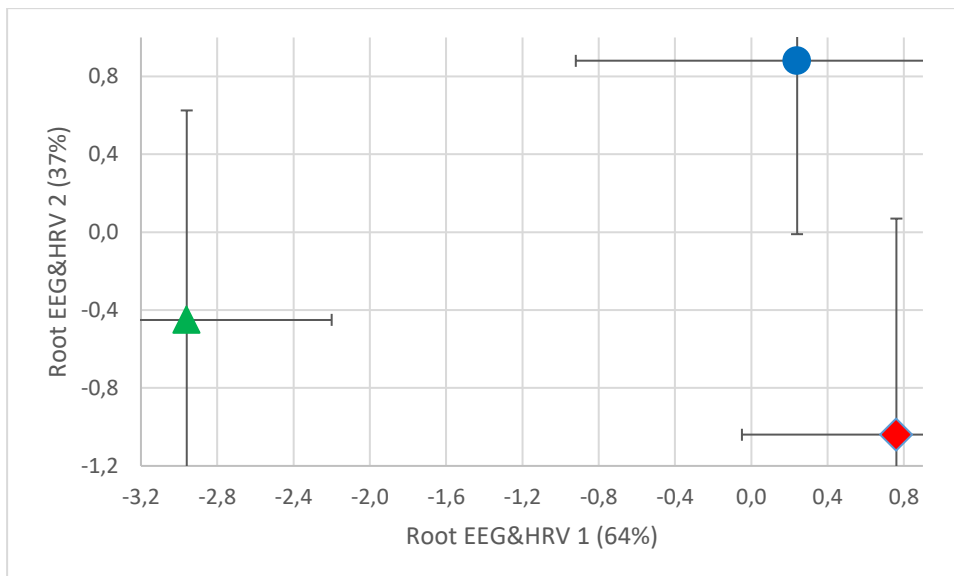


Fig. 2. Average (Mean±SD) of the first and second GDV, EEG and HRV roots of the patients before and 1,5 hours after application of control water or balm

The neurotropic effects of the balm are accompanied by significant changes in a number of GDV parameters. First of all, it is a decrease in the initially normal values of GDI fractality in the right and frontal projections and entropy in the right projection in combination with an increase in the GDI area in the right projection. It is important that the entropy of HRV decreases and the entropy of EEG in occipital loci increases. The physiological essence of entropy is discussed in detail in a recent monograph [13].

The biophysical and informational/mathematical essence of these parameters is unquestionable for unbiased scientists. Chakra issues remain debatable, in our opinion, **for now**. It will be recalled that even until the mid-1960s, the “most advanced Soviet science” denied the existence of genes (??).

We found that after applying the balm, the energy of the **virtual** first, fourth, fifth and seventh chakras increases significantly. And now let's remember that **fourth** and **fifth** Chakras associated with vagus nerve [10], the tone of which increases; **first** Chakra is associated with adrenals, consistent with increased PSD of ULF band as a marker of circulating catecholamines and glucocorticoids; **seventh** Chakra associated with **right** (paired EEG loci!) and upper brain [10].

The previously identified effects of the balm on the parameters of immunity and hemodynamics [1,11,12,15,26,34] are consistent with the notion that **fourth** Chakra is associated with thymus, celiac and cardiac plexus, heart, circulation [10,48]. It is appropriate to mention the research data of our laboratory on the relationship between the parameters of EEG &HRV and immunity, as well as their changes under the influence of adaptogenic factors of the resort of Truskavets' [29-33, 39-47].

Based on the fact that the balm activates the **fifth** Chakra, we risk predicting its short-term thyrotropic effect, as shown for Naftussya bioactive water [27,28].

The cluster of individuals in the control group was shifted along the axis of the first root in the opposite direction, which reflects the sympathotonic shift of autonomous balance and opposite changes in EEG parameters. It is unlikely that the reason for such changes in neurodynamics is the use of 50 ml of tap water. The neurotropic effects of individuals' occupational activity within 1,5 hours between tests and/or the ultradian biorhythm of the autonomic nervous system and cortisol are more obvious.

Interestingly, slight displacements along the axis of the second root were almost the same in both groups.

In general, all GDV&EEG&HRV clusters on the planes of two roots are quite clearly delineated, which is documented by calculating the Mahalanobis distances (Table 6).

Table 6. Squared Mahalanobis Distances between EEG&HRV Clusters, F-values (df=39) and p-levels

Groups	Base-line (74)	After CW (54)	After Balm (20)
Baseline (74)	0	4,80	12,48
After CW (54)	2,83 10^{-4}	0	15,07
After Balm (20)	3,72 10^{-6}	4,16 10^{-6}	0

The same discriminant parameters can be used to identify the belonging of one or another person to one or another cluster. This purpose of discriminant analysis is realized with the help of classifying (discriminant) functions (Table 7).

Table 7. Coefficients and Constants for Classification Functions

Clusters	Base-line (74)	After CW (54)	After Balm (20)
Variables	p=,500	p=,365	p=,135
ULF/TP, %	-3,715	-3,497	-3,898
F3- α PSD, %	-1,323	-1,338	-1,576
P4- δ PSD, %	2,082	2,017	1,769
C4- β PSD, $\mu V^2/Hz$	-0,059	-0,067	0,060
Ch2 Asymmetry	-82,42	-80,78	-81,02
T4- β PSD, $\mu V^2/Hz$	-0,005	-0,028	-0,065
Fp1- α PSD, %	0,467	0,372	0,488
P4- δ PSD, $\mu V^2/Hz$	0,182	0,217	0,215
LF/HF	4,406	4,551	4,624
Asymmetry- β , %	-0,176	-0,229	-0,177
O2- θ PSD, %	0,587	0,595	0,881
Frequency- β , %	-0,412	-0,523	-0,835
O1- θ PSD, $\mu V^2/Hz$	0,242	0,232	0,210
C3- α PSD, %	1,760	1,976	1,940
Ch5 Energy	-59,01	-52,98	-48,47
T6- α PSD, %	1,948	1,943	1,804
C4- β PSD, %	-0,381	-0,317	-0,551
P3- β PSD, %	4,229	4,191	4,409
Entropy HRV	429,2	427,8	443,2
HF PSD, msec ²	-0,013	-0,014	-0,015
Ch1 Energy	-95,01	-102,8	-98,87
T3- α PSD, $\mu V^2/Hz$	0,042	0,038	0,018
F3- α PSD, $\mu V^2/Hz$	-0,192	-0,216	-0,199
O2- α PSD, $\mu V^2/Hz$	0,024	0,028	0,028
O2- α PSD, %	-0,670	-0,729	-0,718
T6- β PSD, %	1,106	1,193	1,261
T4- β PSD, %	-0,541	-0,645	-0,721
RMSSD, msec	-0,689	-0,904	-0,657
pNN ₅₀ , %	3,469	3,726	3,449
F3- β PSD, $\mu V^2/Hz$	0,070	0,101	0,078

Asymmetry- θ , %	0,487	0,443	0,471
Shape C Right	16,86	15,99	16,28
Shape C Frontal	8,862	9,298	9,383
O1- β PSD, %	-0,926	-0,853	-0,893
Area GDI R, kpixels	65,89	66,04	67,01
T3- α PSD, %	1,387	1,498	1,541
Entropy O1	187,2	193,3	181,5
O1- θ PSD, %	-4,974	-5,080	-4,653
Ch7 Energy	-199,2	-196,8	-205,3
Constants	-1463	-1466	-1500

In this case, we can retrospectively recognize members in the initial state with 8 errors, after using control water - with 8 errors, and after applying the balm - with 2 errors. Overall classification accuracy is 87,8% (Table 8). This is 6.7% higher than in our previous study [50].

Table 8. Classification Matrix for EEG&HRV Clusters

Rows: Observed classifications; Columns: Predicted classifications

	Clusters	Base- line	After CW	After Balm
Clusters	% Correct	p=,500	p=,365	p=,135
Baseline (74)	89,2	66	8	0
After CW (54)	85,2	8	46	0
After Balm (20)	90,0	2	0	18
Total	87,8	76	54	18

The digital data of Table 5 are visualized in Figure 3.

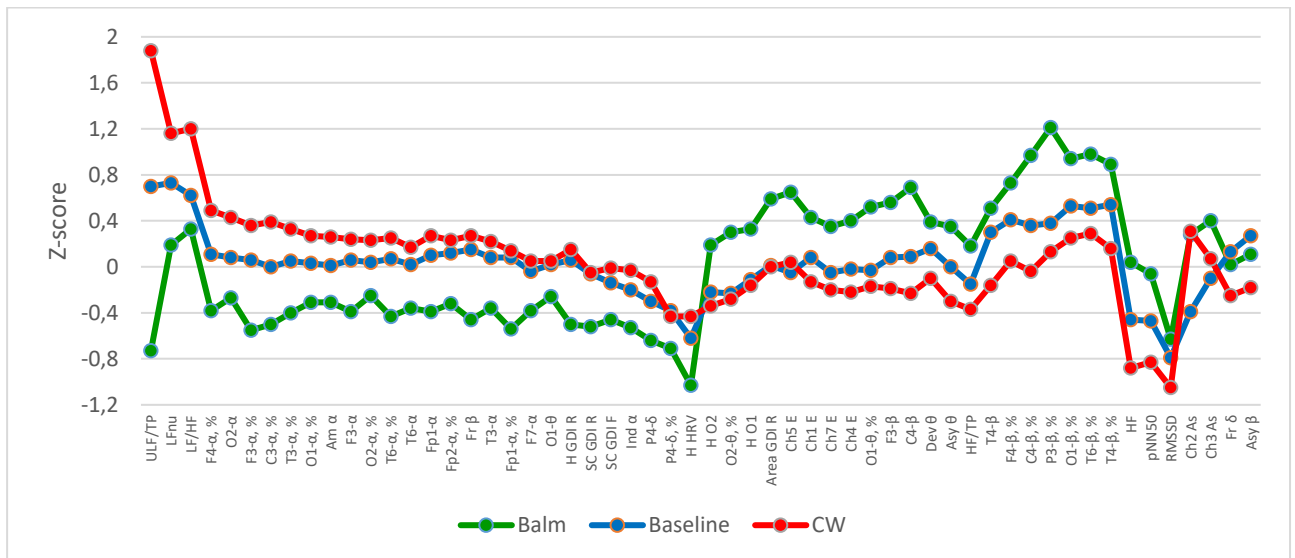


Fig. 3. Profiles of Z-scores of EEGs and HRVs variables in the initial state and 1,5 hours after drinking control water or balm

A clear divergence of profiles is visible, however, it is heterogeneous. Therefore, for more detailed analysis, the profiles were structured in 9 homogeneous patterns. This approach also makes it possible to model the own (per se) neurotropic effects of the balm as algebraic sums of effects in the main and control groups.

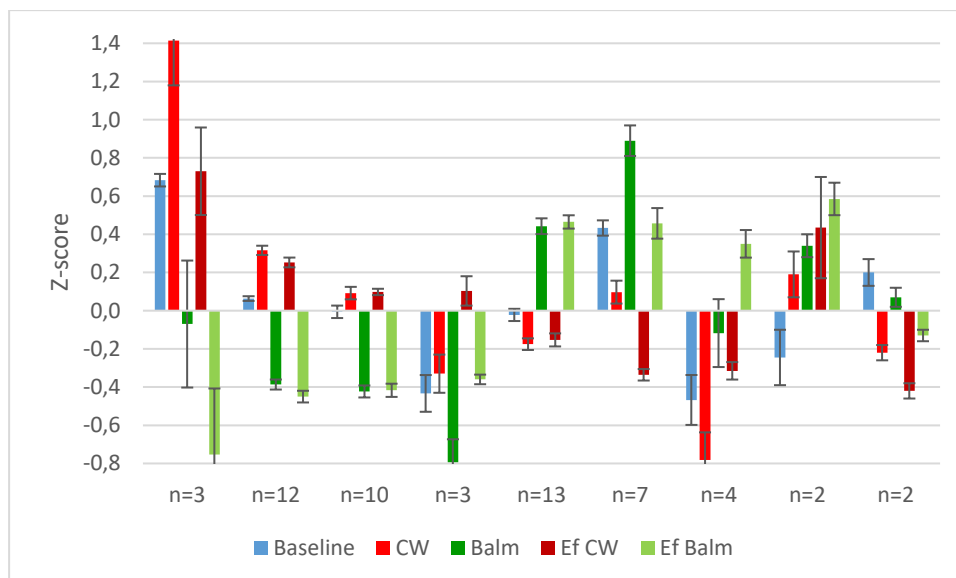


Fig. 4. Patterns of GDV, EEG and HRV (Mean±SE) parameters before and 1,5 hours after application of control water or balm and simulated effects per se. The members of the patterns are separated in table 5 by spaces

Regarding the factors of neurotropic effects of the balm, it is possible to assume the presence of polyphenols, which are present in both the balm [1,36,37] and bioactive water Naftussya [17], whose neurotropic and endocrine effects are well known [11,12,15,26,28,46,47].

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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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