The influence of biogenic extremely low frequency EMF on vitality and longevity of fruitflies *Drosophila melanogaster*

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For Drosophila as well as for many other insects is peculiar metamorphosis - the change in an organism from egg stage to larva and chrysalis and, at last, to adult form. The process is accompanied by profound morpho - functional alterations [1]. On the stage of chrysalis practically all previously formed systems (with the exeption of Malpigian channels and head ganglia undergo lysis and new systems are forming instead of them [2]. Imago, i.e. adult flies, after taking off from chrysalis are practically postmitotic organisms. Only the cells of the reproductive system and middle gut continue to divide, to proliferate [3]. It has been shown that all along the life the cell composition of an adult fly's organism is in fact unchanged [4]. As the result of this the organism of adult Drosophila may be considered as the set of synchronously aging (growing older) cells [5].

Thus the peculiarities of Drosophila's ontogeny allow to use this organism in experiments that are aimed at the study of the influence of biogenic EMF on "pure" genetic structures (at the egg stage) as well as on vigorously proliferating cells (at the stage of larva and chrysalis) or on postmitotic non-dividing cells of imago.

In the frame of the presented paper the flies' longevity and various parameters reflecting their vitality are studied after the influence of thermal stress and biogenic EMF on chrysalises.

Material and methods

The outbreed Oregon-R wild type laboratory population of Drosophila melanogaster was used in the experiments. The eggs were laid down into three-liter glass vessels containing a standard medium composed of sugar, agar, dried yeast, semolina porridge and mold inhibitor nipagin. They were constantly kept at +250 C, the humidity of the experimental cabinet was 40-60% RH. Proper administration of light (12 hours of light and 12 hours of darkness) was employed. Flies were kept in three-liter vials until the end of metamorphosis.

On the 3d day of the stage of chrysalis flies underwent the influence of the two different heat shock regimes: a) 120 min. at 370C - the "activating" heat shock regime (AHS); b) 120 min. at 400C - the "depressing" heat shock regime (DHS). In our previously done experiment s these regimes were selected in such a way that the first one would not evoke 30-40% mortality among chrysalises and the other one (DHS) would do it.

Three groups did not undergo the influence of biogenic EMF this is the normal control group, the control group for HSA flies and the one for HSD flies.

The other groups brought about four experimental groups that differed one another by the quality of electromagnetic information they experienced. The samples of normal and HS-treated chrysalises

(activated or depressed) were placed into the input "beaker"-electrodes of the device BICOM. Two plan hand electrodes and Magnetic Depth Probe electrodes were used to direct biogenic EMF onto three-liter glass vessels with chrysalises of experimental groups. During the influence the electrodes were placed perpendicularly one another. The BICOM and the metal box containing input electrodes (to shield them against background noise) were grounded.

The modulation of the acquired biogenic EMF was done using the program 'A 1, frequency run 10", continuously, 1 min.

Experimental groups were influenced 4 times a day with 30 min. interval between every session.

Thus there were 7 studied groups each of 2000 specimens.

In the table 0. the source-organism and acceptor of the transduced electromagnetic information are presented.

Table 0.

N of group	REGISTRATION	on the INPUT	on the OUTPUT
1	intact NORMAL - N	-	-
2	CONTROL HSA - A	-	-
3	CONTROL HSD - D	-	-
4	A-N	HSA	NORMAL
5	D-N	HSD	NORMAL
6	A-D	HSA	HSD
7	N-D	NORMAL	HSD

- On the 3d day after the eclosia of imago flies of every group were transferred into 0.5 liter vials containing 50 ml of food substance, approximately 600-700 entities in each vial. Females and males lived together. Groups N, A and A-N, D-N consisted of 6 vials, but groups D, A-D and N-D consisted of 4 vials each because of high rate mortality (30-40%) on pre-imaginal stages. Food substrate was changed every other day.

- **The mortality** of the flies was estimated twice a day (at the morning and at the evening) by observation of vials and counting the number of dead Drosophila. On the basis of this data, the mean life span **(MLS)** was calculated for every group. The Maximal Life Span was calculated as the mean life span of the last 10% of flies from a total populations.

Besides, in all groups we estimated the indices that characterize vitality of flies such as: the body weight, the intensity of metabolism (by the quantity of exhaled CO_2), the resistance to starvation and heat shock, fecundity of females and the flies' mortality on pre-imaginal stages in the generation F1 (the offspring of experimental flies)

- **body weight (mg)** was estimated by weighting of 500 males and 500 - 10 times, with 50 specimens every time)
- **the intensity of metabolism (mmol/ml ??)** was assessed from the quantity of exhaled by flies CO2 . For this the sample of 50 specimens separated by gender was left for 3 hours in a well-isolated vial. Then 0.8 ml of air was taken from within a vial using a syringe and cautiously injected into the input channel of the gas-analyzer ‘’. The device estimated the quantity of CO2 in 0.8 ml of the air. For every group 20 samples were prepared, 10 samples of males and 10 of females. Finally we calculated the quantity of CO_2 exhaled in a 1 min. by 1 mg of body weight because in different experimental groups flies had different weight and the time spend by them in the vials of gas-analyzer also slightly varied.
- **the females’ fecundity (egg/day) -** on the 3d day after metamorphosis was completed 1 male and 1 female were placed into a vial with food for 24 hours. 10 vials for every group were prepared. We counted the mean quantity of eggs laid down to the end of a day for every group of vials.
- flies’ **mortality in F1(imago/eggs %)** generation was estimated as the quantity of imago taking off from the eggs laid down by females of P generation (by ‘parents’ from experimental groups)
- **Starvation resistance (hours):** 50 specimens were placed in a vial without food at 22^0C. The time of the death of every fly was recorded. Twenty vials (10 with males and 10 with females) were prepared for every group of the experiment.
- **Heat shock stress-resistance (number of dead/total number %):** 50 specimens (25 of males and 25 of females) were maintained in a vial with food at 40^0C for 150 min. The quantity of dead flies in a vial was counted 18 hours later. Ten vials were prepared for every group of the experiment.

Statistical analysis was done using statistical program "STATGRAPHICS" [6].

Results and discussion

The stage of chrysalis is the stage with maximal activity of system’s formation high [Medvedev N.N.,1968; Ginter E.K.,1978]. That is why it is plausible to expect that the influence of high temperature on chrysalises may induce dramatic alterations in its program of development.

As it can be seen from table 1 the weight of males was slightly changed after the influence of temperature on chrysalises. We did not find significant differences of the weight from the intact value in group A as well as in group D.

At the same time if the weight of females from group A practically does not very then in group D the applied thermal treatment decreases the weight of females.

The following after a heat shock influence of biogenic EMF cause considerable alterations of males’ and females’ weight.

Table 1. The Mean Weight of flies

weight of	males (mg)	t	females (mg)	t
groups	M ± m		M ± m	
N	0.89±0.01		1.37±0.012	
A	0.91±0.03	-0.63	1.36±0.01	0.00
D	0.89±0.01	0.00	1.3±0.01 p<0.009	2.68
A-N	0.9±0.01	0.71	1.33±0.01	1.34
D-N	0.94±0.01 p<0.005	-3.54	1.44±0.02 p<0.01	-2.83

In the groups of depressing HS (Table 2.) the treatment of chrysalises with biogenic EMF brought about the increase in the weight only females from the group A-D (the transmission of the e.m. information from 'activated' chrysalises)

Table 2. The Weight of HS-depressed flies

	males	t	females	t
groups	M ± m		M ± m	
D	0.89±0.01		1.3±0.01	
A-D	0.91±0.01	-1.41	1.36±0.01 p<0.004	-4.24
N-D	0.9±0.02	-0.45	1.28±0.02	0.45

From the discussed above results one may draw a conclusion that in certain conditions acting biogenic EMF may modify the normal development of flies resulting in the body weight increase. Moreover this factor may eliminate the negative effect of stressing thermal shock on weight and recover its normal values.

Because body weight varied in different groups during the estimation of the metabolic intensity in flies' organisms the index was not calculated for one specimen but it was done for mg of body weight in a group.

Heat shock significantly decreases the metabolism of females from D group (table 3).

Biogenic EMF of HS depressed chrysalises increases the rate of metabolism of 'normal' males from group D-N.

Table 3 The rate of metabolism (according to CO_2 concentration)

groups	males		females	
	M±m	t	M±m	t
N	10.88 ± 0.63		22.42 ± 1.35	
A	12.92 ± 0.65	-1.56	21.73 ± 0.65	0.46
D	12.36 ± 0.43	-1.94	16.18 ± 0.86***	3.90
A-N	12.19 ± 0.42	-1.73	21.18 ± 0.75	0.80
D-N	13.83 ± 0.59***	-3.42	22.96 ± 1.24	-0.29

* - $p < 0.05$; ** - $p < 0.01$; *** - $p < 0.001$.

In the groups of depressing HS (Table. 4) the influence of biogenic EMF slightly decreases the metabolism of male from the group N-D and increases it of female from the group 'A-D'.

It is possible that the information encoded in the spectrum of e.m. waves of chrysalises may induce opposite alterations in the metabolism of intact flies. As we shown it depends on the organisms that situated in the input electrodes. If the EMF of HSD chrysalises are influencing in which metabolism was increased by HS then the metabolic rate turns to be increased. If the influencing EMF carries information about normal metabolic rate (or about processes controlling its normal value) then the HS-increased rate of metabolism decreases.

Table 4 The rate of metabolism (according to CO_2 concentration) in groups of DHS

groups	males		females	
	M±m	t	M±m	t
D	12.36 + 0.43		16.18 + 0.86	
A-D	11.83 + 0.61	0.71	19.79 + 0.72**	-3.22
N-D	10.62 + 0.70*	2.12	18.24 + 1.16	-1.43

The resistance of males from experimental groups to the condition of complete food deprivation (mean life span - hours) varies though these variations (groups A and A-N) are not well expressed ($p<0.05$, Table 5.). It seems to be true that females are more sensitive to the influence of temperature and EMF. The starvation resistance of females appears decreased compare to the intact control in group D, A-N, D-N.

Table 5. Mean life span of flies in the conditions of starvation (hours)

groups	males		females	
	M±m (hours)	t	M±m (hours)	t
N	19.13 + 0.14		44.85 + 0.42	
A	18.71 + 0.14*	2.12	44.39 + 0.48	0.72
D	19.44 + 0.15	-1.51	39.11 + 0.48***	9.00
A-N	19.52 + 0.14*	-1.97	43.42 + 0.44*	2.35
D-N	18.96 + 0.14	0.86	42.15 + 0.43***	4.49

It is interestingly that while mean life span of males from A group was decreased than their maximal life span turned to be increased (compare group a from table 5 and 6). Maximal life span become shorter in group D-N (table 6) while mean life span is left unchanged. With regard to females one can say that depressing HS decreases both their mean and maximal life span in the condition of starvation.

Table 6. Maximal life span of flies in the conditions of starvation (hours)

groups	males		females	
	M±m (hours)	t	M±m (hours)	t
N	26.38 + 0.26		61.68 + 0.47	
A	25.64 + 0.23*	2.13	63.22 + 0.35*	-2.32
D	26.78 + 0.20	-1.22	58.76 + 0.49***	4.57
A-N	25.76 + 0.20	1.89	61.24 + 0.49	0.91
D-N	25.20 + 0.16**	3.87	60.82 + 0.50	1.52

The application of bioresonance influence to flies of HS depressed groups acts upon the starvation resistance of males and females in contrary ways. If both mean and maximal life span of females in group N-D grows than for males that indices are decreased in group A-D, and in group A-D only mean life span is decreased (Table. 7,8).

Table 7. Mean life span of HS depressed flies in the conditions of starvation (hours)

groups	males		females	
	M±m	t	M±m	t
D	19.44 + 0.15		39.11 + 0.48	
A-D	17.91 + 0.14***	7.46	39.79 + 0.46	-1.02
N-D	18.50 + 0.13***	4.74	41.06 + 0.40**	-3.12

Table 8. Maximal life span of the HS depressed flies in the conditions of starvation (hours)

groups	males	t	females	t
	M±m (hours)	t	M±m (hours)	t
D	26.78 + 0.20		58.76 + 0.49	
A-D	25.12 + 0.21***	5.72	57.48 + 0.52	1.79
N-D	26.40 + 0.23	1.25	60.93 + 0.60**	-2.80

The lethality of imago after 18 hours of heat shock is distinctly increased only in D group while comparing to the intact value (Table. 9). Quite unexpected was the result of significant increase in the lethality of females and males from group A-N and only females from group D-N. The influence of biogenic EMF have never caused such profound decrease in the vitality of flies.

Table 9. Heat-shock resistance. Lethality (%) of flies after 18 hours of heat shock.

groups	males		females	
	M±m (%)	t	M±m (%)	t
N	14.20 + 2.67		17.80 + 3.31	
A	11.20 + 2.46	0.83	12.45 + 2.67	1.26
D	71.20 + 5.25***	-9.68	73.85 + 2.99***	-12.57
A-N	56.95 + 4.79***	-7.80	56.95 + 4.79***	-6.72
D-N	43.15 + 5.21***	-4.95	26.35 + 3.54	-1.76

The effects of biogenic EMF on HS-resistance were not so pronounced in groups of depressing HS: lethality of males was increased in group A-D and lethality of females was decreased in group N-D (Table. 10).

Table 10. Heat-shock resistance. Lethality (%) of flies after 18 hours of heat shock.

groups	males		females	
	M±m (%)	t	M±m (%)	t
D	71.20 + 5.25		73.85 + 2.99	
A-D	85.80 + 3.27*	-2.36	75.40 + 4.03	-0.36
N-D	77.25 + 4.31	-0.89	59.55 + 4.07*	2.38

Fecundity of females was not changed neither after HS treatment nor after the influence of biogenic EMF (Table 11.)

Table 11. Mean Fecundity of females (egg/day)

groups	fecundity (egg/day)	compare	
	M±m		t
N	7,84 + 1,37		
A	7,70 + 1,37	to N	0,07
D	9,95 + 2,18	to N	-0,82
A-N	7,11 + 1,48	to N	0,36
D-N	7,10 + 1,36	to N	0,38
A-D	9,95 + 1,12	to D	-1,19
N-D	11,60 + 2,01	to D	-1,55

Though the quantity of eggs did not very significantly (Tab.11) the quality did because the rate of the mortality of the flies of F1 generation on pre-imaginal stages (before the completion of metamorphosis) significantly varied from group to group (Table. 12). The survivorship of immature forms of flies was especially high in groups A, A-N, D-N. The highest mortality was observed in group D - it was almost 6 fold higher than in intact group. As it was noted in 'material and methods' almost the same rate of mortality (40%) was observed in this group among chrysalises of P generation.

Table 12. The quantity of the survived flies in F1 generation related to the quantity of the eggs laid down by the females of P generation (%)

groups	imago/eggs %	compare	
	M±m		t
N	81.63 + 3.95		
A	94.94 + 1.59**	to N	-3.13
D	14.93 + 7.30***	to N	8.04
A-N	91.39 + 2.53*	to N	-2.08
D-N	97.65 + 1.15***	to N	-3.89
A-D	31.21 + 8.62	to D	-1.44
N-D	39.93 + 7.40*	to D	-2.41

The increase in the quantity of the survived flies was determined after the influence of EMF in HS-depressed groups too, though the index was significantly distinct from the value of the HS-depressed control only in the group N-D

The results of Mean Life Span and Maximal Life Span (MLS and MxLS) obtained for large populations of the flies of the P generation (not less than 1000 flies in a group) are the most interesting and representative results of the experiment.

One can see (table 13.) that activating HS practically did not influence on both MLS and MxLS of

males and females. Whereas depressing HS significantly reduced MLS of flies of both sex (table 13) and to a certain degree diminished MxLS of males (table 14.) The influence of biogenic EMF considerable prolonged either MLS (tab.13) or MxLS (tab.14) of females in group A-N

Table 13. Mean Life Span of flies (days)

groups	n of flies	males		n of flies	females	
		M±m (days)	t		M±m (days)	t
N	1983	75.32 + 1.91		2239	38.56 + 1.03	
A	1926	77.91 + 1.79	to N -0.99	2036	39.70 + 1.05	to N -0.78
D	1346	65.60 + 2.32**	to N 3.24	1277	29.67 ± 1.18***	to N 5.65
A-N	1493	79.14 + 1.68	to N -1.50	1811	48.03 + 1.31***	to N -5.67
D-N	1910	76.21 + 1.82	to N -0.34	2046	40.99 + 1.12	to N -1.60
A-D	1011	72.74 + 1.87*	to D -2.40	1193	40.25 + 1.21***	to D -6.26
N-D	1139	70.70 + 2.09	to D -1.63	1201	38.49 + 1.33***	to D -4.96

The influence of biogenic EMF on the chrysalises of HS depressed groups allows to raise the MLS and MxLS of females in groups A-D and N-D (tab. 13,14). For males this effect was significant only in group A-D - the increased MLS was observed - though less expressed than that for females.

Table 14. Maximal Life Span of flies (days)

groups	n of flies	males		n of flies	females	
		M±m (days)	t		M±m (days)	t
N	1983	95.75 + 0.99		2239	54.50 + 2.10	
A	1926	96.25 + 1.13	to N -0.33	2036	56.75 + 1.91	to N -0.79
D	1346	90.00 + 2.41*	to N 2.21	1277	52.00 + 2.31	to N 0.80
A-N	1493	96.75 + 1.54	to N -0.55	1811	74.50 + 3.59***	to N -4.81
D-N	1910	95.75 + 1.06	to N 0.00	2046	58.00 + 2.09	to N -1.18
A-D	1011	91.00 + 1.96	to D -0.32	1193	60.00 + 2.65*	to D -2.28
N-D	1139	91.50 + 1.98	to D -0.48	1201	61.00 + 3.32*	to D -2.23

Thus. according to the obtained results we can suggest that:

1. females are more sensitive to the influence of biogenic EMFs than males;
2. biological EMFs more effectively influence on the Mean Life Span than on the Maximal Life Span of flies

Particular conclusions

- The application of biological EMFs allows either to modify the process of normal development of flies enhancing their body weight or to eliminate negative effects of a depressing HS normalizing their reduced weight
- A short exposure of chrysalises to the influence of temperature (depressing HS) considerably reduces the rate of metabolism of females. The influence of biogenic EMFs either recovers the metabolic intensity up to the level comparable with intact or increases metabolic activity of intact flies (D-N, males).
- It is difficult to explain the effects of EMFs on the resistance of flies to stress stimuli. The starvation resistance of females become higher and of males smaller after the influence. The HS resistance of thermally-intact males and females from group A-N become increased. In group D-N the index is increased only in females. The stress-resistance of HS-depressed flies is lowered in group A-D (only for males) and increased in N-D (only for females). Presumably sex of flies play a certain role in reactions of flies on stress stimuli.
- After heat shock the survivorship of the flies of the F1 generation during metamorphosis was enhanced in group A and diminished in group D. It is clear that bioresonance treatment alters not only the vitality of flies as it is but also the viability of their eggs. As a result the quantity of the flies that successfully finished metamorphosis is increased in groups A-N and D-N.
- The transmission of e.m. information from the chrysalises of group A to group N causes considerable prolongation of mean and maximal life span of females. The mean life span of HS-depressed females is dramatically increased in both groups A-N and N-D. For males it was observed only in the group A-D.

General conclusions

The transmission of biogenic EMF from the organisms that underwent stress to intact organisms allows to reproduce (or replicate ?) in the latter the pattern of system response to stress conditions. In several instances that influence bring about the increase in vitality of imago (stress-resistance, the survivorship of parents and their offspring)

By certain regimes of biogenic EMFs it is possible to eliminate negative effects of stress-influence. That is these fields may play controlling functions in an organism being out of equilibrium (in an organism in pathologically unstable state)

An improvement of some functions after the influence of EMFs may be accompanied by a deterioration of another functions because of a ‘reconstruction’ of homeostatic mechanisms of life maintenance.

Discussion

The results presented in this report were obtained by the estimation of the system response of the Drosophila organism. The concrete molecular and biophysical mechanisms that would allow to explain the obtained results are still unknown. However we can suggest some explanation that can be logical.

In our experiment the influence of HS and EMF was performed of the stage of chrysalis. The indices characterizing vitality of the organism were studied on the stage of imago (i.e. adult organism). Thus, after the applied influences young chrysalises passed through the last stage of metamorphosis. On the stage, almost all physiological systems formed earlier, on the larva stage, either entirely collapse or fundamentally reorganize its activity (e.g. nervous system). Therefore it would be difficult to suggest that the observed alterations may be accounted for by the induction of changes in physiological systems of the organisms. The observed also difficult to explain on the background of biochemical adaptation: it is well known that proteins taking part in stress adaptation are short living and their life span may number in several hours. From our point of view the most likely explanation of the results could be genome adaptation of chrysalises to the applied influences.

Over a long period of time genom have been considered as a closed system - highly conservative biopolimer matrix that codes information that is necessary for the process of differentiation, development and normal functioning of an organism. It was supposed that considerable fluctuations within the organism's environment can result in either profound disturbances of genetic material (mutations) or in passing and reversible (at once after the disappearing of a stress stimulus) alterations in the character of genetic expression. The letter happens, for example, in the situation of heat shock.

However, within the past few years a lot of data have been obtained that make possible to argue that genom is an open system, as also phenotype is. It directly reacts on any exogenous stimuli [7-10]. It has been shown the possibility of genom adaptation of animals to low temperatures of their environment, to low concentration of oxigene in the aier, to heavy phisical activity [8], to pathogenic infections, oxidative stress, to the stress evoked by heavy mtak loading of an organism [7]. During last years the biomolecular mechanisms that allow for genom to preserve for a long time adaptive alterations in unstable environment have been studied. It is supposed that such alterations may occur on the functional level of genom as well as on its structural level. The first type of alterations is known as epigenetic inheritance or cellular memory - the preservation of the pattern of genes' expression induced by exogenous stimuli in the row of generations [11-15]. On the structural level the tandem amplification of eucaryote regions of a genom may occur [16], directional (non-random) adaptive mutagenesis [17-21] and the translocation of mobile, transposable elements (jumping genes) from their dwelling place to the specific loci that have adaptive character may happen [22-30].

If it is granted that there are induced directional alterations of a genom then, probably, the mechanism with high sensitivity and selectivity should exist that is responsible for the transmission of exogenous stimuli to a genome. Physiological and biochemical processes, which have been revealed and studied up to now, are not enough reactive and selective to be treated as possible mediators in superfine

relationships between genome and environment. A great deal of recently appeared data evidence that ultraweak electromagnetic waves may be the carriers of the regulator information that through various bioreceptors may be conveyed into genome [31].

Some scientists suppose that the central dogma of molecular biology is obsolete [10,31-32]. Simply, it means that besides the inflow of information from DNA to proteins, the opposite direction of the process is also feasible and may give rise to the new inherited status of genom. It was verified in the investigation of the influence of external agents on the phenotype of an adult organism provided that the influence was applied at early stages of embriogenesis [33]. And it is noteworthy that electronagnetic fields is supposed to be the carriers of information in the system with the pathway 'proteins-genes' [31]. Suppositions like the mentioned above give rise to the concept of 'wave' genome. According to the concept an 'electromagnetic cocoon' is associated with the material carriers of heredity - with genes. This electromagnetic structure possesses ultrafine sensitivity and selectivity to exo- and endogenous information about any meaningful for a cell (and an organism) alterations in surrounding conditions. With this in mind it is easier to understand why even vain in its energy e.m. signals can change the character of gene expression [34-36]. This can happen due to the interaction between exogenous and endogenous oscillations. It results in appearance of signals coming directly to genome and changing the pattern of its expression. It is supposed also that effective exogenous EMF with certain parameters of amplitude and frequency should be so match to parameters of endogenous EMF that resonance interaction could take place [37-38]. Naturally it is easier to get resonance for an organism if its electromagnetic matrix comprise in general coherent oscillations and the coherence of intrinsic oscillations actually was proved. Almost instantaneous reaction of an organism on the chain of environmental events is well accounted for by resonant character of the 'cell-environment' interactions.

Speed, sensitivity and selectivity of the electromagnetic mechanism of regulation of the system 'environment-genome' give to an organism certain privileges compare to the classical Darwin's organism taking privilege by chance. For pure Darwinistic organism its evolution and inherited adaptation is based on random 'successful' mutations. In this instance, after 'good' mutation happened an acquired adaptive feature may be propagated over all population only much later and will dominate perhaps in the 10th or 100th generation. In contrast to this adaptive feature can instantaneously appear and be fixed in genome at once after the meaningful alterations in the environment if the system of electromagnetic regulation is taken into considerations. These system of statements often bumps into the objections that argue about the impossibility of such high sensitivity of genome to exogenous EMF. Indeed, how could an organism with extremely sensitive genome exist in the environment permanently full of various e.m. oscillations. Such argument seems irrelevant because of the occurrence of 'biological window'. Adey's windows [39] are certain region of amplitude and frequency, often they are quite narrow, where an organism is extremely sensitive to EMF of that parameters even if the energy of background e.m. noise is higher. [50,41].

Taking into account the ideas of the 'wave genome' and 'open genome', which is able to reflect

on structural and functional level important changes in environment and keep them in 'memory' for a long time, we should try to look ones more at our results:

Most likely the influence of stress factors on chrysalises may affect the vitality of imago as follows:

1. by the influence of HS on physiological status of developing flies;
2. by an increase in the rate of random mutations;
3. by non-random selection;
4. by the production of HS-proteins (or stress proteins) [42];
5. by preservation over long period of time of the changes in genetic activity;
6. by the appearance of adaptive alterations on the structural level of genome (so called "directed mutagenesis).

Now we step to the analysis which supposition is appropriate for the explanation of our results. For every one of them one paragraph would be devoted.

1. It is known that the stimulus enhancing vitality should be moderate by its intensity and applied to the physiological systems of an organism several times [43]. However, in our experiments thermal stress was quite strong by its energy and was applied only one time. Contrary to this, biogenic EMFs were very weak (0.2-0.4 mkV) and influenced 4 times. Besides, the impossibility to preserve adaptive reactions by physiological systems that passed through metamorphosis with profound reformation of tissues is in poor agreement with the supposition No 1.
2. Practically all spontaneous somatic mutations diminish vitality;
3. The supposed selection might take place only in the groups of Depressing HS because thermal stress could be the force of pressure. Moreover, we should emphasize that vitality in that group (D control) was decreased
4. If HS-proteins would be long-lived proteins then the effects observed on the stage of imago could be explained by the production of a huge number of HS-proteins in the cells of chrysalises after Heat Shock. Then that proteins could effectively defend imago against stresses during periods of ontogeny. However, the proteins are short-lived [44,45], the life span of many of them not longer than several hours.

Therefore, in the frame of the first four versions it is practically impossible to explain how the strong influence (or strong stimulus + weak EMF) applied on the early stage of the flies' ontogeny could lead to the increase in the vitality of imago.

From the other point of view the proposed events on structural and functional level of genome may be feasible solution for the problem. Thus genom adaptation could occur due to both the regulated mutations and inherited level of the genes of stress-resistance.

As we shown, the increase in the vitality was observed not only in HS-treated flies but in the group of intact flies, which experienced biological EMF of the HS-treated chrysalises. Keeping in mind that the intensity of e.m. signals was very low, one can suppose that the changes were induced not by the energy of the signals but owing to information recorded in signals about the pattern of the organism's

reactions on a stress.

As it was pointed out above, stress factors of an environment influencing on genome may lead to the changes of vitality [1, 46-49].

As this takes place it is important not only the character and dose of an influence but the current stage of the organism the influence acts upon. Thus, it was reported that the sensibility of Drosophila embryos to exogenous factors drops to its minimum after the 3 d hour of the development [46]. Also there is data proving that the rise of long-lived phenotypes of Drosophila depends on genetic events taking place on the larva stage of the development [50]. It is found that the Drosophila's molecular genetic mechanisms regulating longevity are related to the events that occurred during the first week of their life after metamorphosis [51]. During the aging (getting older) the responses of a genome on stress conditions are dramatically changed. In particular, the ability of an organism to switch on stress-genes and, thus, to produce HS-proteins is significantly reduced [52-53]. From the other hand, it was demonstrated [54] that the selection of long-lived populations of Drosophila leads to the rise of the increased stress resistance in such newly-formed subspecies. Besides that populations is characterized by lowered intensity of metabolism.

All this together is in a good agreement with our data. The author of the discussed article [54] expressed supposition that stress-resistance and longevity from one hand and the rate of metabolism from the other hand are related to each other by the methods of antagonistic pleiotropy.

In conclusion:

If there is the correlation between stress-resistance and longevity the non-specific stimulation of the stress-resistance genes during early stages of development by environmental factors of certain intensity may be one way to increase vitality and prolong life. The utilization of regulating biological EMF in the development of new 'epigenetic geroprotectors' has an important role.

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