

# Effect of Hypomagnetic Field on Water Medium of Living Systems

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## ABSTRACT

The article represents the generalizing data for the studying of the effect of hypomagnetic field on physico-chemistry properties of water and bio-objects. It was revealed the changing state of water: increasing of its oxidation-reduction potential and oxidative properties as magnetic induction attenuated pointing to a natural decline, that testifies about the regular decreasing of internal energy of water molecules, which, in our opinion, is caused the inhibition of the germination of seeds of the highest plants, embryonic development of *Planorbarius corneus* and the changing of energy state of growing mediums for cell culture of mammals. It is supposed that namely the changing state of water is the main component in the effects of weakening of magnetic field on the studying bio-objects.

## 1. INTRODUCTION

In previous investigations of our laboratory [1-3] showed that water possesses unusual sensitivity to the least hardly distinct manifestations of solar activity. Besides, water medium is undergoing direct action of gelio-physical factors. So, in model experiments [1-5] changing of oxidation-reduction properties of water under the effects of environment factors (“electromagnetic” background, ionized radiation, hypomagnetic field (HMF), under eruptions of volcano, solar eclipse) was established. Effect of surrounding near-Earth space on biological objects changes must inevitably accompany with the alteration of inner medium of bio-objects which basis consists of water. As a result water structure can be changed, it renders accordingly immediate effect on physiological processes in living organisms. It is well-known that the concentration of water molecules in cells exceeds in 2 - 3 sequence, the concentration of protein and other molecules in cytoplasm. In this, it should note that yet I. M. Sechenov thought, that “organism without outer environment, supporting its state is unfeasible”, that’s why in scientific determination of organism it ought to include the environment, effecting on it [6].

All living organisms are the products of long biological evolution as a result some mechanisms, supplying their maximal adaptation to specific conditions of Earth, are formed. Some of environment parameters, such as, for example, gravity, remain more or less constant during significant periods of time, while others constantly change. One of the constantly effecting factors is geomagnetic field of Earth, which changes depending on latitude, increasing to the poles, so average its induction consists of 42 mkTl. The value of geomagnetic field induction in near-Earth space is significantly lower than on Earth surface and reaches 0.0066 mkTl in inter-planet space, 0.3 mkTl on the Moon's surface, ~0.7 mkTl on the altitude of 200 km from the Mars's surface [7]. And, although geomagnetic field doesn't stay constant both to induction and to configuration [8], its changing for the period of animal life can consider negligible. What is sharp changing of geomagnetic field isn't factor of natural selection. Animal reaction on it isn't fast genetically and can be the most diverse.

Effect of some alterations of natural geomagnetic field of Earth on organisms is summed up in monographs [9-11].

There are significantly fewer works devoted to the influence of sharp jumps of the induction of geomagnetic field on animals and plants. It is shown that the influence of static magnetic field, weakening with screening, with induction value less than 20 mkTl, disturbs the functional state of living organisms [7]. In the present in connection with the realization of projects on cosmic flights out of near-earth space similar investigations have a special currency [12].

Besides, the question about the ratio of the influences on organism direct effect of HMF and influence of changing environment due to this factor, is not clear. In this connection it was logically to investigate, how water properties will change under the effect of the weakening of magnetic field, and how in this the changing water properties reflect on the vital functions of bio-objects, as A.-L. Lavuazje considered, "life is a continuous circuit of oxidation-reduction processes, occurring in organism". The integrative parameter of these processes is the value of oxidation-reduction potential (ORP) of biological mediums of organism [13]. According to I. M. Bahir's opinion, ORP should be considered as homeostatic character of biological liquids of organism [14]. In this connection the interest represented the studying of such properties as ORP and hydrogen parameter (pH).

The model experiments for the studying of the effect of a 40-100-fold attenuated geomagnetic field on physical-chemical properties of the water of high cleaning [1]—(*model system*), physiological characteristics of seeds of the highest plants [4], the embryonic development of freshwater gasteropods mollusk Great Ramshorn *Planorbis corneus* [3] and growing mediums for cell culture of mammals [5]—(*living systems*) were fulfilled in our laboratory. The purpose of this investigation is to generalize and analyze the receiving data in brief.

## 2. PHYSICAL-CHEMISTRY PROPERTIES OF WATER UNDER THE HYPOMAGNETIC CONDITIONS

### 2.1. Method

All investigations were fulfilled using the water of high cleaning (deionized water with initial conductivity 0.3 mkSm/sm<sup>2</sup>), in this aim distilled water was undergone many-stage cleaning with ion-exchange on the apparatus OOO "Hydrotech", Moscow.

It was investigated the effect of a 40-100-fold attenuated geomagnetic field (~1.0 mkTl) on the ORP and pH values of water. First of all were determined (by the ORP value) the alterations of water medium properties in hypomagnetic chamber (HMC) — the device "Screen ferromagnetic", produced in Zelenograd, Moscow region. HMC represented a cylinder, making from 15 lays of permalloy, inner diameter = 110 mm, L = 500 mm. A uniformness of weakening of magnetic field along the chamber length reached with the help of creating wall thickness of chamber to the point of 15 mm and controlled due to magnetometer. With this aim the separate glass vessel with water was accommodated into the chamber on the different depth of changing induction of magnetic field with a help of ionomer I-160MI. Besides two samples of water were taken and preliminary measured ORP value and pH, the first sample served control, the

second sample of water was set for 8 days in HMC. In 8 days in the investigating samples of water were measured ORP value and pH.

## 2.2. Effect of Weakening of Magnetic Field on ORP and pH Value of Water

### 2.2.1. Effect of Weakening of Magnetic Field on Water ORP Value

In the investigations of the effect of a 40 - 100 fold attenuated geomagnetic field (~0.5 - 1.0 mkTl, that is corresponds approximately to the level of magnetic field gradient on the Moon's and Mars' surface) [15], for the first time it was revealed the increasing of water ORP value as the weakening of the induction of magnetic field in HMC (Figure 1) [3]. It testifies about "the regular decreasing of internal energy of water molecules" [16] and the increasing of its oxidative properties. Apparently, in conditions of weakening of magnetic field the energy of electron excitement in water molecules decreases due to the lack of pumping up of the energy from geomagnetic field. Thus, HMF increased the oxidative properties of water.

### 2.2.2. Effect of Weakening of Magnetic Field on Water pH Value

Besides that, hypomagnetic conditions lead to the decreasing of pH value of water. So, in geomagnetic conditions ORP value of water consisted of 169 mV, pH = 7.1. Eight days later staying in HMC water ORP value increased for 44% to 243 mV, pH decreased to 5.9 (for 72%) for this, *i.e.* in the conditions of HMC oxidative properties of water enhanced (Table 1).

In usual conditions water ORP, measured relatively chlorine-silver electrode comparison, is, as a rule, positive and consists 120 - 170 mV under the neutral hydrogen parameter pH = 7.0. Under the accommodating for a long time (8 days) glassy bucks with water in HMC, which decreasing the torrent of outer factors-electromagnetic irradiation, and weakening the induction of geomagnetic field in 40 times, the influx of outer energy from geomagnetic field brings down. Apparently, it induces the decreasing of disturbance

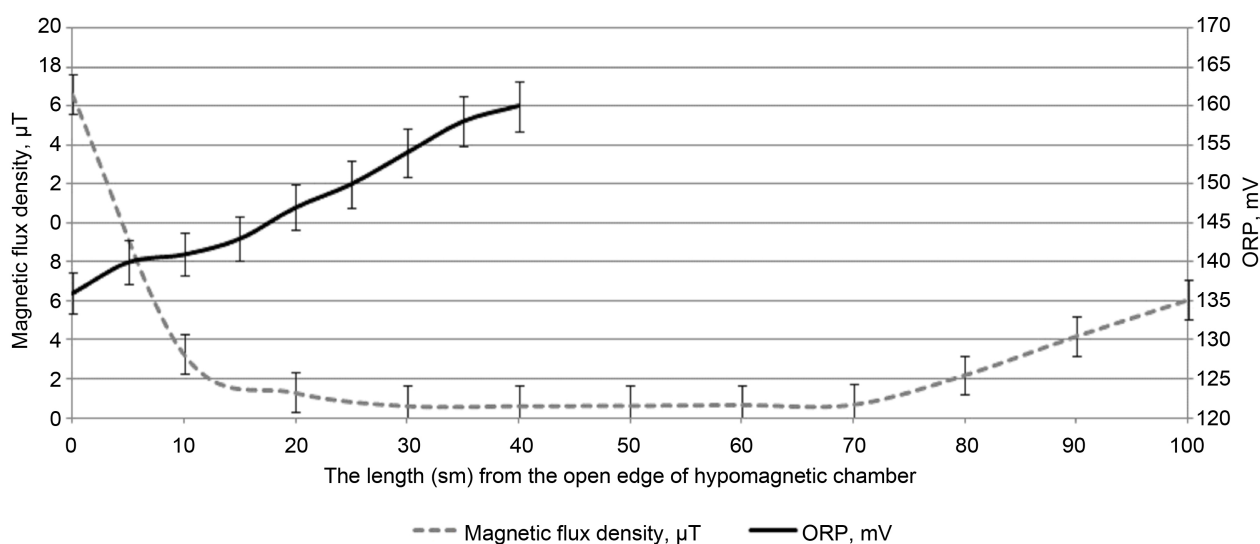


Figure 1. Dependence on ORP and magnetic flux density.

Table 1. The alterations of water ORP and pH value after the 8-days staying in hypomagnetic chamber.

Parameters	Geomagnetic Field	Hypomagnetic Field
ORP	169	243
pH	7.1	5.9

hydrogen links, the diminution of inner energy of water molecules and the increasing of water electron-acceptor properties, *i.e.* oxidative capacity of water enhances (increasing of ORP value). Further as a result of electron-exchange interactions between water molecules their dissociation and the increasing of hydrogen ions concentration (the decreasing of pH value) occurs.

Thus, hypomagnetic conditions increased of water ORP value and decreased of pH value, *i.e.* altered redox properties of water, increasing its oxidative ones.

It is represented the special interest to elucidate how it will affect the changing water state (undergoing to HMF) on the living systems.

### **3. PHYSIOLOGICAL CHARACTERISTICS OF SEEDS OF THE HIGHEST PLANTS UNDER THE HYPOMAGNETIC CONDITIONS**

#### **3.1. Method**

The seeds of the high plants were chosen as biological object. It is known that the seeds are steady to the radiation than the whole plant. It is also established that the seeds of the cruciferous family are the most sensitive to the irradiation. However the cruciferous' reaction to hypomagnetic conditions is studying quite a little. Besides the cruciferous are the best antioxidants. In this, the cruciferous family is not to be underestimated for the further using on cosmic flights.

It was fulfilled 4 series of investigations [4]. Airy dry certificated seeds of radishes *Raphanus sativus L.*: pink-red (firm "Sedek"), radishes *Cherry bomb* (firm "Burpee"), radishes "Sango" and Red Pepper sweet *Capsicum annuum* (firm "Burpee") served as the objects of investigation, which for their morpho-physiological features relate to the highest plants because of they are *Magnoliophyta*, or *Angiospermae*.

The radishes dry seeds and red pepper seeds (50 ones) were put in three cup of Petri (diameter 4 cm) on 2 layers of filter paper, wet with settled during a day water-piped water and stayed to grow in normal geomagnetic field (8 days). It served as control (1-st series). In the 2-nd series, prepared analogically control series, the cups of Petri were put in the chamber with a 40-fold attenuated geomagnetic field (~1 mkTl) during 8 days. In the 3-rd series the radishes dry seeds wet with settled during a day water-piped water, preliminary put for 30 minutes in the chamber with weakening geomagnetic field, as far as water condition, undergoing to outer influence, is formed not moment, but 15 - 30 minutes later, when the net of hydrogen links are formed [16]. Then the seeds were stayed for the germination under normal geomagnetic field. The 4-th series—the radishes dry seeds (50 ones) were put in cup of Petri and accommodated in HMC during 8 days. After that these seeds, prepared analogically control series, were stayed for the germination under geomagnetic field.

#### **3.2. Effect of Weakening of Magnetic Field on Rising and Germination of Seeds**

##### **3.2.1. Effect of Weakening of Magnetic Field on Rising of Seeds**

The rising and germination of seeds are the percent of growing seeds in the sample taking for an analysis. The energy of seeds germination is the speed of growing of the seeds (3 - 4 days).

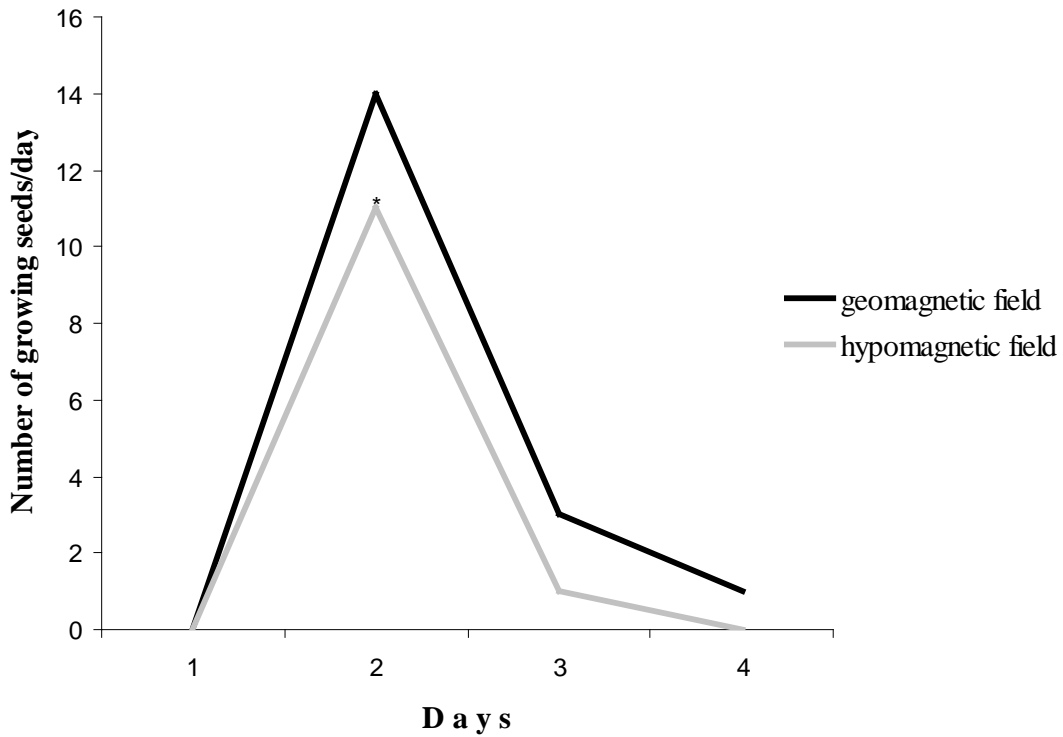
As it is known, radishes seeds sprout on the 2-nd day. It was interesting to compare the germination radishes seeds under the different conditions: geomagnetic (control) and hypomagnetic (experiment) field. It was shown the decreasing of the number of growing seeds in HMC (Figure 2).

##### **3.2.2. Effect of Weakening of Magnetic Field on Germination of Seeds**

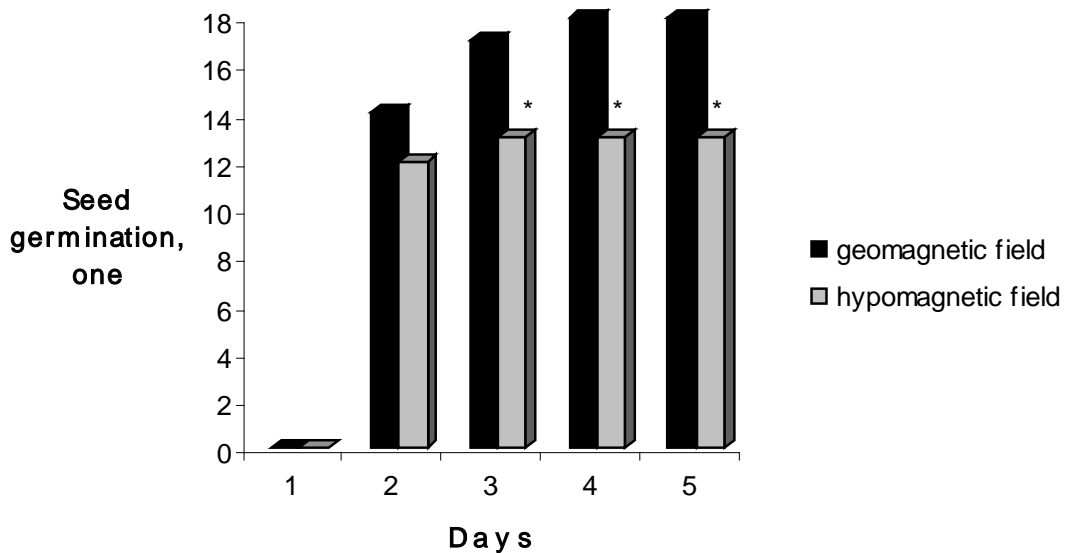
The influence of HMF on the seeds of radishes "Sango" during 5 days led to the changing of the rising of seeds. So, in conditions of HMF the rising of the seeds was reliable less than in control (Figure 3).

##### **3.2.3. Effect of Weakening of Magnetic Field on Growing Characteristics of Sprouts**

The rising is the number of normal germinating seeds, *i.e.* these are the sprouts which have



**Figure 2.** The rate of radishes seeds germination per day. \*The reliability of results differences ( $P \leq 0.05$ ).



**Figure 3.** Dynamics of the rate of seed germination radishes "Sango", staying in hypomagnetic chamber during 5 days. \*The reliability of results differences ( $P \leq 0.05$ ).

well-developed the main structures—counterfoil, hypocotyl, epicotyl and plumular hook (7 - 8 days). A counterfoil germinates at first, then—hypocotyl.

In normal geomagnetic field with the magnetic induction 40 - 43 mkTl (control) the number of

growing seeds of red pepper consisted of  $25 \pm 2$ ; pink-red radishes— $16 \pm 1$ ; Cherry Bomb radishes— $23 \pm 2$  ones. The length of counterfoil consisted of  $2.84 \pm 0.5$  cm,  $2.66 \pm 0.3$  cm and  $5.10 \pm 1.0$  cm, the length of hypocotyl— $3.54 \pm 0.4$  cm,  $1.85 \pm 0.2$  cm and  $3.40 \pm 0.6$  cm, correspondently, that was in the range of norm for the parameters of physiological characteristics of these kinds of the highest plants seeds (Table 2, Table 3).

Under the weakening geomagnetic field (the 2-nd series) it was noticed the decreasing of germination energy of the radishes and red pepper seeds for 23% and 37%, correspondently, in comparison with the control series. The development of the sprouts of two kinds of the radishes and red pepper significantly slowed down, that it was found their reflex in the decreasing of the length of counterfoil and hypocotyl in 4 - 5 times and in 2.5 - 5.5 times, correspondently, in comparison with control (Table 2, Table 3).

Thus, HMF led to the decreasing of the rising and the germination of seeds.

Indirect due to the water, which was preliminary undergone to exposure during 30 minutes in the conditions of a 40-fold attenuated geomagnetic field, the effect of the weakening geomagnetic field was also affected on the rising of seeds and the development of the sprouts of two kinds of radishes (3-rd series). So, the number of the rising seeds of two kinds of radishes was less 15% - 25% of the value in control investigations and reliable didn't differ from the same value in the 2-nd series. The values of the length

**Table 2.** The rising of seeds and growing characteristics of red pepper sprouts in the conditions of normal (control) and the weakening geomagnetic field ( $x \pm S$ ).

Parameters	Control	Hypomagnetic Field, mkTl
Number of growing seeds	$25 \pm 2$	$9 \pm 1^*$
The length of counterfoil (cm)	$2.84 \pm 0.5$	$1.14 \pm 0.2^*$
The length of hypocotyl (cm)	$2.84 \pm 0.5$	$0.65 \pm 0.1^*$

Note: \*the reliability of results differences ( $P \leq 0.05$ ).

**Table 3.** The comparison of physiological characteristics of radishes seeds depending on germination condition ( $x \pm S$ ).

Parameters	<i>Pink-red radishes</i>			<i>Cherry bomb radishes</i>		
	Geomagnet. Field (control)	HMF (direct action)	Geomagnet. Field (indirect effect of HMF via water)	Geomagnet. Field (control)	HMF (direct action)	Geomagnet. Field (indirect effect of HMF via water)
The rising of seeds (ones)	$16 \pm 1$	$13 \pm 1$	$14 \pm 1$	$23 \pm 2$	$17 \pm 1^*$	$18 \pm 1^*$
The length of counterfoil (cm)	$2.66 \pm 0.4$	$0.60 \pm 0.1^*$	$0.73 \pm 0.1^*$	$5.10 \pm 1.0$	$1.06 \pm 0.2^*$	$1.60 \pm 0.2^*$
The length of hypocotile (cm)	$1.85 \pm 0.2$	$0.45 \pm 0.05^*$	$0.60 \pm 0.1^*$	$3.40 \pm 0.6$	$0.65 \pm 0.1^*$	$1.20 \pm 0.1^*$

Note: \*the reliability of results differences ( $P \leq 0.05$ ).



of counterfoil and hypocotyl of the seeds in the 3-rd series were some more than the parameters in the seeds of the 2-nd series, but also were in 3 times less in comparison with control measurements (Table 3). So, the rising and germination of the seeds, wetting with the water, preliminary put for 30 minutes in the chamber with weakening geomagnetic field, and then germinating under normal geomagnetic field, were also more less than control.

Thus, a 40-fold attenuated geomagnetic field both direct and indirect effect due to the water, led to the decreasing of the rising and the development of the sprouts of the seeds of two kinds of radishes.

It is a special interest, to our mind, is the results of the 4-th series. Direct hypomagnetic conditions (exposition of dry seeds in HMC during 8 days) didn't induce the reliable effect on the physiological characteristics of radishes dry seeds, *i.e.* the speed of growing and the number of normal germinating seeds in geomagnetic field were the same both in control seeds and in dry seeds, preliminary accommodated during 8 days in HMC. These data confirm ones more about that HMF effect is due to the changing of water state.

One can be concluded, that the decreasing in forty times the magnetic field of Earth, reached in per-malloy chamber, led to the increasing of water oxidative properties and significantly suppressed the rising and energy of germination seeds.

## **4. THE EMBRYONIC DEVELOPMENT OF GREAT RAMSHORN *PLANORBARIUS CORNEUS* UNDER THE HYPOMAGNETIC FIELD**

### **4.1. Method**

Parental individuals *P. corneus* with mass approximately 500 mg, grown in aquarium conditions under natural geomagnetic field, were kept in HMC (10 individuals) or in normal conditions (12 individuals). The conditions of keeping: room temperature (23°C); settling not less 2 days water supply 1 l in volume; constant feeding with fresh leaves of dandelion; replacement of water and rest of food occurred 2 times a week. Mollusks transferred from HMC in normal conditions in a 1.5 month. Fertility (the amount of clutches per one individual in twenty-four hours) accounted every week. Clutches and hatching from it mollusks were used for the fulfilling the experiments.

Clutches, receiving in normal conditions, on the stage of zygote were cut in two and put in 5 ml of settling water supply in plastic Petri caps closed with lid. One of these clutches was grown in the conditions of HMF, another one—in normal conditions. Photography of developing clutches realized in interval of 5 min till the hatching of vital embryos with help of microscope AM-311 Dino-Lite Digital Microscope. The stage of development, embryo line sizes and their age in units of physical time (t) and biological time (T) were determined on getting pictures [17, 18].

Embryo mobility assessed due to the comparison of consequent frame of photography. It is considered that embryo transferred if its position for 5 minutes changed more than 20 minutes. Index mobility is accounted: the part of intervals in which embryo displacement was observed, in % from total number of 5-minute intervals. In clutches 62 embryos were measured.

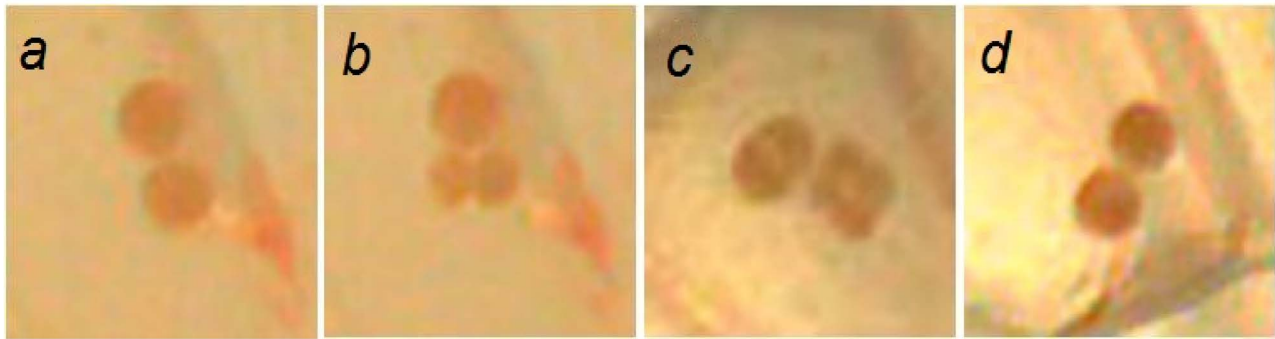
We'll consider HMF effect on embryonic development of *P. corneus* in brief.

### **4.2. Effect of Magnetic Field Changing on Embryonic Development**

Mainly the hypomagnetic field effected beneficial influence on the development of mollusks: teratogenic effects were less massive, *i.e.* embryos that first occurred in hypomagnetic conditions were characterized by low death rate.

The forming of identical twins in HMC was marked in 1 case: blastomeres, created after the 1-st cell division, they fully separated and began to divide every one independently. On the stage of late morula their development stopped (Figure 4). Similar effect never earlier observed both in normal conditions and in conditions of any experimental effects.

Under the displacement of clutches out of HMC in normal conditions all embryos died during the



**Figure 4.** The forming of identical twins *P. corneus* in hypomagnetic chamber. Age of development: a—0 hours (stage of 2 blastomeres; point); b—2 hours; c—3 hours; d—26 hours (stage of morula).

day independently on their stage of development.

#### 4.3. Effect of Hypomagnetic Field on the Mobility of Embryos

As for mobility embryos was observed that, after embryo settling on capsule wall on the stage of middle veliconch the reliable differenced appeared. It occurred due to the increasing of mobility index in HMC, while in normal conditions index mobility didn't change. Evaluated degree of mobility in HMC observed also on the stage of post-metamorphosis in comparison with control (Figure 5).

#### 4.4. Choosing by Juvenile *P. corneus* Induction of Magnetic Field

After the displacement of mollusks in normal conditions the growth speed sharp decreased practically to complete stop growth in all individuals. A majority of mollusks was lost.

Majority of mollusks grown in normal conditions during twenty-four hours choose the area with maximal magnetic induction which was out of HMC. Mollusks grown in HMC, on the contrary, during twenty-four hours migrated deep into the chamber. Majority of them choose the most distant area from the exit of HMC, *i.e.* the area with minimal induction (Figure 6).

Thus, it is necessity to note that the decreasing of magnetic field evoked mainly beneficial effect on the development of *P. corneus*. Embryos, which first were in geomagnetic field, are characterized by decreasing mortality. However, the alteration of induction in increasing side, occurs serious pathological effect on animals: embryos rapidly death and juvenile mollusks practically stop their growth and majority of them death too. For the mature mollusks the alterations of vitality and fecundity isn't revealed.

## 5. OXIDATION-REDUCTION PROPERTIES OF GROWING MEDIUMS FOR CELL CULTURE OF MAMMALS UNDER THE EFFECT OF HYPOMAGNETIC FIELD

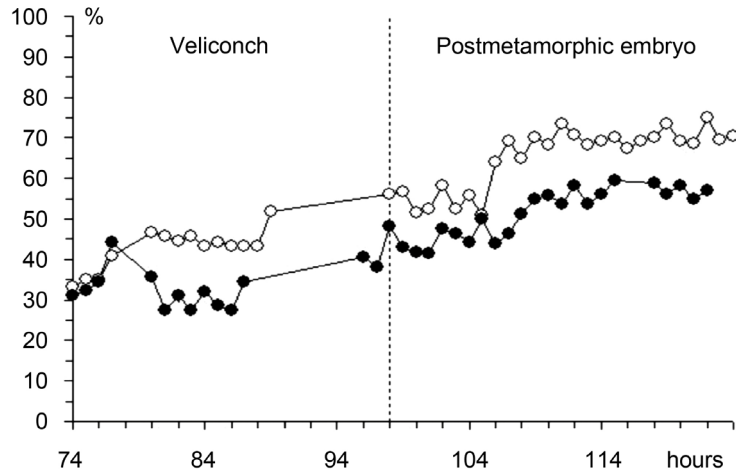
### 5.1. Method

Water is capable to reflect the effects of outer factors in their structural changing which correspondently occur direct influence on the physiological processes in organism. The effect of environment factors on biological mediums is little studying. The investigation of the processes in biological liquids plays the important role in the assessment of the influence of environment during the flight in inter-planet space.

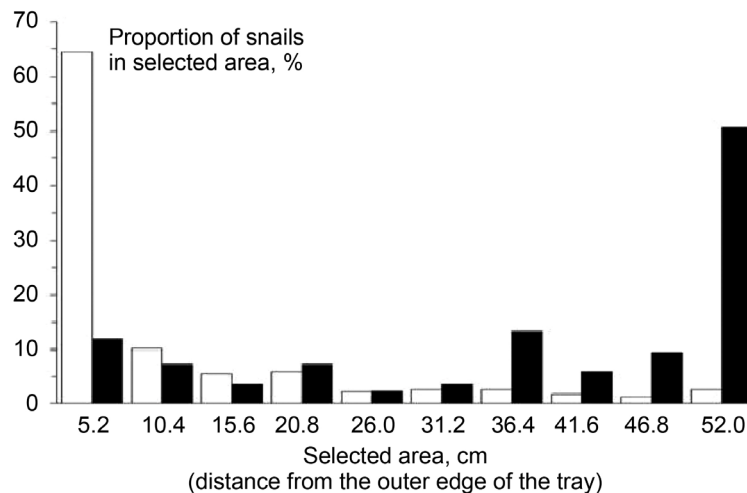
However, it should be noted that there are some difficulties during the carrying out of ORP measuring in biological mediums due to electrochemical method. These difficulties are connected with the fact that in oxidation-reduction systems it is necessary to take into account not only the oxidation-reduction properties of the investigating medium, but and the state of electrode surface [19]. Given this, we considered it is expedient to fulfill the investigations on the *model of biological medium*.

In model experiments were studied the effect of hypomagnetic field during 2 days  $\approx$  1 mkTl on the





**Figure 5.** Kinetics of embryo mobility index changing in late embryogenesis. X-axis—embryo age; Y-axis—mobility index, accounting for 1 h of development. White circles—HMC; black circles—normal conditions. Dotted line—the board between the stages of development.



**Figure 6.** The part of mollusks choosing the different area of the tray. White columns—mollusks, grown in normal conditions; black columns—mollusks, grown in HMC.

physic-chemical properties (ORP and pH) of growing medium for cell culture of mammals as nutrition medium 199 (PanEco, Russia). It was used a clear solution of medium (solution 1) and with the adding of 10% embryo bull serum—model of bio-medium (solution 2). The samples of solutions were set in HMC during 2 days.

## 5.2. Effect of Hypomagnetic Field on ORP and pH Values of Nutritional Mediums

It is already noted the difference in initial meaning of values of studying parameters of solutions in geomagnetic conditions. So, in solution 1 ORP value = 160 mV, pH = 8.3, and in solution 2, correspondingly, ORP = 100 mV, pH = 7.7 (Table 4).

**Table 4.** Comparison of dynamics of ORP and pH values of investigating solutions.

Conditions of experiment	Parameters			
	ORP, mV	pH	ORP, mV	pH
	Solution 1		Solution 2	
Geomagnetic conditions	160	8.3	100	7.7
Hypomagnetic conditions	110	6.8	73	7.3

In our opinion, these differences explain by the fact, that water molecules, which connected with negative charged protein molecules in solution 2, possess higher electron emission, *i.e.* protein molecules are capable easily to give up electrons in medium. In the result ORP value falls due to the larger formation of dissociated water molecules. In this the concentration H<sup>+</sup> increases and pH value falls.

Hypomagnetic conditions evoked the decreasing of ORP and pH value in both medium solutions (Table 4), that testifies about the changing of energy state, mainly water molecules and their quantity.

Thus, HMF significantly changes the oxidation-reduction properties of growing mediums. The investigation of the processes in biological mediums plays the important role in the assessment of environment effect during the flight in inter-planet space.

## 6. DISCUSSIONS

Thus, it was revealed for the first time the increasing of ORP value of water under the magnetic induction attenuated pointing to a natural decline. Under the accommodating for a long time (8 days) glassy bucks with water in HMC, which decreasing the torrent of outer factors-electromagnetic irradiation, and weakening the induction of geomagnetic field in 40 times, the influx of outer energy from geomagnetic field brings down. Apparently, it induces the decreasing of disturbance hydrogen links, the diminution of inner energy of water molecules and the increasing of water electron-acceptor properties, *i.e.* oxidative capacity of water enhances (increasing of ORP value). Further as a result of electron-exchange interactions between water molecules their dissociation and the increasing of hydrogen ions concentration (the decreasing of pH value) occurs.

The increasing of ORP value testifies about “the regular decreasing of internal energy of water molecules” and the increasing of its oxidative properties, which, in our opinion, is caused the inhibition of the germination of seeds. It is supposed that namely water is the main component in the effect of HMF.

The universal receptor of the fields and amplifier of its action is water, more exactly, water basis of living organisms. Under the effect of a 40-fold attenuated geomagnetic field the electron generation of water molecules decreases (work of electron leaving increases). So long as living organisms are water structures, the amount of water excited molecules, are capable to give back the electrons, decreases and ORP value grows and dissolving water properties change under HMF. ORP characterizes the state of inner biological environment of organism. Under the decreasing of the amount of excited water molecules due to HMF a less of its amount penetrates into the cells, water medium of cytoplasm, organelles and biochemical functions occurring in it are activated in less degree, *i.e.* the metabolic processes inhibit. Apparently, the slowdown of biochemical processes under the sharp weakening of magnetic field from normal level caused the slowdown of seeds growth. In accordance with the position of change water medium state under the effect of HMF one should consider, in our opinion, the lowering of rising and slow down of the development of the seeds sprouts, what testifies about that, the determine action of HMF effect is the change of the water medium state. Evidently, the slowdown of biochemical processes under a sharp increase of magnetic field to the normal strength also caused the revealed stop of growth and death of the majority of juvenile

mollusks on experiments. Besides that, from a position of the alteration of water medium state under HMF effect one should to consider the established increasing of embryo mobility index on the stage of middle veliconch and on the stage in post-metamorphosis. So long as great ramshorn belongs to trochophore animals it forms a special larva-trochophore, on the apical pole on it is an apical sensor organ—"larval brain", which takes part in catching of outer signals and launching of metamorphosis. These nervous cells effect on the rates of development. Exceptionally serotonin synthesizes in great ramshorn (on the stage from trochophore to middle veliger). As it is established [20], under the neuron activation the development of the larvas of great ramshorn slows down under serotonin (in 3 - 4 times), under the decreasing of neuron activation the reliable accelerated development is observed. Proceed from these concepts, one can suppose that weakening magnetic field activates neurons of trochophore *P. corneus* as the result the slow-down of the development till embryo death in our experiment under a sharp increase of the magnetic field to normal level.

As for growing mediums for cell culture of mammals under HMF, it was established the significant changing of its oxidation-reduction properties, it testifies about the changing of energy state, mainly water molecules and their quantity. Further investigations will show, how the state of growing mediums, undergoing to the influence of HMF, will declare on the growth of cell cultures of mammals.

Besides it isn't expelled the influence of reactive oxygen species, increasing under HMF. So, in the recent investigations [7] was shown that erythrocytes, undergoing the effect of the weakening with screening magnetic field, produced much more reactive oxygen species than ones, which was under the magnetic field of Earth.

It is supposed that namely water is the main component in the effects of HMF on bio-objects, which acts due to the alterations of the properties and structural content of water.

It is necessary to suppose that in the environment under the effect of cosmo-physical factors, including hypomagnetic field, the same alterations in outer and inner water medium of bio-objects, occur, it reflects on their vital functions, growth and development.

## 7. CONCLUSIONS

1) It is established that the oxidation-reduction potential of water increases as magnetic induction attenuated pointing to a natural decline, that testifies about "the regular decreasing of internal energy of water molecules" and the increasing of its oxidative properties.

2) A 40-fold attenuated geomagnetic field both under direct and indirect effect due to the water led to the decreasing of the rising and the development of the sprouts of seeds of the highest plants.

3) Under the effect of hypomagnetic field it was observed the inhibition of embryonic development of *Planorbarius corneus*.

4) Hypomagnetic field significantly changed the oxidation-reduction properties of growing mediums for cell culture of mammals; it testifies about the changing of energy state, mainly water molecules and their quantity.

5) In our opinion, namely the changing state of water is the main component in the effects of weakening of magnetic field on the studying bio-objects.

## CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this paper.

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