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ELECTROMAGNETIC FIELD OF LOW FREQUENCY AND COMMUNICATION SYSTEMS IN MICROORGANISMS

Bakhodir Mukhamadiev[1], Shurangiz Kasimova[2], Nodirabegim Kasimova[3]

[1] *Associate Professor, Department of Chemistry, Bukhara Engineering and Technology Institute, Bukhara, Uzbekistan*

[2] *Master`s Degree Holder, Tashkent Pharmaceutical Institute, Tashkent, Uzbekistan*

[3] *Student, Bukhara State Medical Institute named after Abu Ali ibn Sino, Bukhara, Uzbekistan*

ABSTRACT

The role of EMF in biological systems is considered in a large number of works performed by various foreign scientists. The energy imparted to the EMF system by the ELF field is much less than the energy of thermal movements. But no work discusses the issues of impulse exchange in biological systems, and first of all, between molecules of (flexible) γ- protein and membranes that act as a capacitor of electrical impulses. The purpose of the article is to fill this gap in science by discussing the literature data on the effect of ELF and ELF EMFs on biological systems, primarily, the protein envelope of the virus + the host cell membrane.

KEY WORDS: ***communication, electrical impulses, cell, virus, bacteria, EMF, ELF, ELF.***

INTRODUCTION

At present, as a result of generalization of a large number of works, it is known that a constant magnetic field (PMF) can significantly change the rate and nature of the growth of microorganisms. Since they, like all other living microorganisms, in the process of life, receive, process and use information about the world around them, it is natural due to their high sensitivity to EMF, especially to ELF (ultra-low frequency) and ELF (extremely low frequency) EMF (1,2) , the question arises about the presence of a communication channel in microorganisms due to various physical fields, which are otherwise called remote interaction. It is possible that the main role in this interaction belongs to ELF and ELF EMF. In this regard, it is necessary to consider the influence of these fields as a factor that is of the same importance in the life of bacteria as temperature, pressure, humidity, radiation, etc. the purpose of this work is to theoretically consider the processes of information exchange between cells and their surrounding compounds (environment) using weak electromagnetic waves.

The effect of weak EMF on microorganisms has the character (nature) of stress, as a result of which the number of colonies sharply decreases, but after some time the number of microorganisms is restored. In addition, after a slight decrease in the number of microbes by 3-5 times in comparison with the control. This nature of population changes is well known in microbiology. Under the influence of a certain unfavorable factor, the number decreases, followed by adaptation of the surviving individuals to it, which is subsequently accompanied by their active reproduction, as a result of which the population size exceeds the optimal one, which causes a decrease in reproduction. The considered phenomena lead to decaying waves of population size in time. So, in the case of ELF EMF action, a stress response of microbes to the effect is observed. Consequently, there is now significant progress in understanding the influence of ELF EMF on physicochemical and biological systems. [3]

Currently, there are a number of hypotheses explaining the mechanism of ELF EMF action on the above systems. The most discussed in the scientific community among them are the following: cluster, NMR, EPR, stochastic resonance, cyclotron resonance, modulation of the velocity of individual particles and particle fluxes under the influence of ELF EMF. At first, the efforts of scientists were directed to the study of the influence of ELF EMF on chemical processes, then, consequently, it is capable

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of influencing biological systems as well. chemical reactions underlie the growth and development of cells, transformation of energy into a form suitable for various biological processes, coding of genetic information, changes in membrane potential capable of transmitting electrical impulses over distances (communication) . When an electric pulse passes through a liquid medium, convection flows can arise in it, which can lead to a redistribution of the substances contained in them, which can cause changes in electrochemical reactions occurring at the membrane-liquid interface. [4]

The energy of interaction of an ion in a solution with a weak electric potential is very small compared to thermal energy. EM P ELF can significantly affect n and orientation of the large asymmetric molecules having a dipole moment, which may affect the steric factor R. The molecules can be oriented in a magnetic field in a direction favorable to the reaction that increases or decreases the likelihood of a favorable impact, respectively. Under the influence of ELF EMF, magnetoanisotropic molecules and particles of a substance, which freely diffuse in a solution, can orient themselves in space. This orientation will occur when the number of monomers is of the order of $n = 10^{8}$-10^{16}, which significantly exceeds the number of amino acids of the protein coat of the virus and can correspond to the RNA molecule. However, the orientation of RNA in solution is primarily determined not by the entire molecule, but by the Coulomb stiffness segment, consisting of several hundred base pairs ($n = 10^{2}$). The very low degree of orientation of the stiffness segments observed in the ELF EMF can lead to significant changes in the three-dimensional structure of RNA, thereby hindering the process of RNA replication. If molecules, due to intermolecular interactions, form cooperative regions with a preferred orientation of molecules, then these regions are often called domains . An external magnetic field is, in principle, capable of causing domain orientation in a macroscopic sample, which leads to a change in many characteristics of solutions. If the domain occupies a membrane area with linear dimensions of several microns, then the orientation effect can be significant. [5]

When studying the effect of ELF EMF on protein structures of SARS - virus, you must take into account the impact of the water environment in which due to the existence of spatially directed γ- links macromolecules acquire the necessary conformation and ability to perform its differential function. With a certain moistening of the protein, it becomes mobile (labile) due to the formation of a layer of bound water on its surface, which is fixed when the virus enters the host cell. By scattering γ- rays: when the critical values of moisture sharply increase the rms amplitude of the oscillations nonhydrogen atoms, and also change the mechanical properties of the protein (allotropic change). When studying the mechanisms of action of ELF EMF, a dependence of a number of effects on changes in the properties of the aqueous phase was found. These data on the influence of ELF and ELF EMF allow us to consider the aquatic environment as one of the universal receptor systems in the process of intermolecular communication. Significant changes in the properties of solvents when a portion of water treated with ELF EMF is added to them, as well as a significant dependence of the manifestation of the effects of EMF on aqueous solutions on the concentration of substances reacting selectively, indicate a significant influence of the aqueous medium on magnetobiological effects, including those associated with communication phenomena. [6]

There is a large class of chemical reactions, the rate of which can be significantly influenced by EMF. These reactions are associated with the stage of interaction of paramagnetic particles. This pair can be in different electronic spin states, which determine different reactions of the system. According to the spin conservation law, a reaction product can be formed only through some channels ("spin ban"). The interaction of an external magnetic field with the spins of the reactants can lead to the opening of new or redistribution of old reaction channels, which, in the case of a short lifetime of a pair in comparison with its spin-lattice relaxation time, can change the rates of the forward and reverse reactions.

There are two possibilities energy conversion of the magnetic field in the orbital energy of the degrees of freedom of the particles, which in the end lead controlled biochemical (immunochemical) reaction. Direct transformation allows the classical analogy of actions on a particle in the form of the Lorentz force. The indirect transformation is related to the spin of the particles. Power direct process approaches the quantum during mu limit in limited areas of biophysical systems (of membrane us) q.s. atom internally protected from the external environment. In these locations, which are often key to biochemical (immunochemical) reactions, nuclear spins become a significant factor. It is noted that the details of the configuration of the magnetic field that are essential for the response of a biological system are: 1) the dependence of the frequency of the effective magnetic field on the magnitude of the direct current; 2) the temporal orientation of homogeneous constant and variable magnetic fields; 3) the states of polarization of the variable ELF EMF. All of these facts are characteristic of the phenomenon of spin magnetic resonance. [6]

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Irreversible chemical reactions create favorable conditions for the biological amplification of weak signals. Many biophysical molecular systems that ensure the proper course of immunochemical reactions have regions protected from external influences, which allows us to conclude that there are no fundamental prohibitions that limit the consideration of molecular biochemical systems as primary receptors for MFs with the participation of spin degrees of freedom. [7]

In the course of life, cells exchange information. At the same time, they generate electromagnetic signals. The ability of biological objects to maintain the constancy of the internal environment under changing external conditions, as well as to adequately respond to signals, is largely due to the functioning of cooperative systems with a threshold response. An example of such a system is the system of voltage- gated ion channels. In such systems, the steady state switching parameter value is close to the threshold , so a small change is sufficient to cause the system to switch. Now the attention of researchers is attracted by the phenomenon of stochastic resonance, which consists in the fact that in a bilayer or multistable system influenced by noise and a periodic signal, the signal-to-noise ratio in the response of the system passes through a maximum when the external noise increases. When there is no periodic signal , the switchings are also purely random, while when a signal appears, they more or less correlate with it. This component of the response correlated with the signal is indistinguishable at low and high noise intensities , but at some intermediate (resonant) value of the noise intensity, the correlation is improved. If we consider the effect of a weak EMF on a cell within the framework of the stochastic resonance hypothesis, then we can assume that the primary antenna is a bistable ion channel. Periodic exposure causes a synchronous change in the conductivity of the ion channel (pull - push) , accompanied by a change in the conformation of the corresponding protein (for example, a virus protein). Also, synchronous rearrangements of many channel proteins can then lead to a synergistic effect with the creation of complex structures on the membrane. [8]

Of particular interest are the effects of ELF and ELF EMFs on the virus-host cell communication systems, especially in light of the recent COVID - 19 pandemic . Studying the links between the increase in solar activity and the spread of various diseases, it was shown that outbreaks of plague, cholera, diphtheria, influenza and other viral infections coincide with periods of increased solar activity. Investigating photobacteria showed that on magnetically quiet days bioluminescence is stationary, but significantly changeable during magnetic storms. Based on a large number of studies, it has been established that a constant magnetic field can strongly affect the growth and reproduction of microbes. [1]

CONCLUSIONS

Thus , the effect of ELF EMF on the biological system (with induction from 1 to 120 mT) leads to resonant electricity with oscillations in the protein molecule, due to the electrostrictive effect in proteins, a mechanical wave propagates in the volume of the protein globule, which, possibly, affects on the processes of communication between the protein membrane in and the rush and the membrane of the host cell. In addition, literature data indicate that the main communication processes occur in the diffusion layer, in which there are no cells and are not associated with membrane processes and RNA. In any of the considered theoretical options, the dominant role is assigned to the protein molecule, which is easily subject to allosteric changes due to its specific spatial structure.

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