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INFLUENCE OF THE MAGNETIC FIELD OF HIGHLY DISPERSED FERROMAGNETS ON SOME BIOLOGICAL SYSTEMS

Abstract: *The results of the study were analyzed in the study of the effect of magnetic fields on highly dispersed ferromagnets in biological systems. The possibility of using high-dispersion ferromagnets for medical and biological purposes has been demonstrated.*

Key words: *magnetic field, high-dispersion ferromagnets, biological systems, biological object, magnetosensitive materials.*

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Introduction

Recently, much attention has been paid to the study of the influence of magnetic fields (MF) on biological objects. These questions are very relevant in connection with the development of methods for the application of MF and their practical use. However, experimental data are insufficient, and sometimes the results obtained are so contradictory and diverse that it is not possible to formulate with certainty the regularities of the effect of MF on biological systems. In addition, modern views on the mechanism of the therapeutic and biological action of MF, the body's response to its effect, the use of MF and various ferromagnets as sources of MF are not always unambiguously reflected. [1-7].

In this work, an attempt is made to generalize some published data and our own experimental results of studying the effect of MF of highly dispersed ferromagnets on biological systems.

Analysis of the effect of MF on physicochemical and biological changes in the body makes it possible to reasonably and purposefully use these fields for diagnostic and therapeutic purposes [9-12].

In many works [13-17], new variants of magnetotherapy, the effect of MF on the physiological functions of experimental animals and humans, as well as research methods based on the interaction of MF with magnetosensitive materials are considered. It is known from the literature that MFs have a biological effect. This explains the use in medicine of methods of treating many diseases. Moreover, numerous studies have shown the absence of specific contraindications to their use [5, 18-20].

Studies of the effect of MF on tumors are of interest [21-25]. This opens up new perspectives and fields of application in medicine, in particular, in oncology.

The use of MF in the treatment of a number of diseases requires control of the MF action, the objectivity of the method, the development of a biodose, the reduction of harmful effects, etc.

Iron ions occupy a special place in the mechanism of the biological effect of MF directly through water systems [26-28]. Of greatest interest for biology and medicine is the study of reactions involving ions of iron, copper, calcium, and other organic molecules and radicals [29–31]. Thus, in a pair of iron - oxygen, conditions are created for the manifestation of the effect of MF on the rate of reactions Fe2 + + 02 - »Fe3 + + 02 [29]. The regularities of the magnetic effects from Fe2 +, 02 can contribute to deepening the study of the mechanisms of catalytic reactions with the participation of Fe2 * at the stages of termination and branching of oxidation

chains [31, 32]. The effect of MF on the reaction rate of the decomposition of hydrogen peroxide by catalase in the presence of iron ions was studied [33], which proceeds by the latent radical mechanism, and the possibility of the formation of intermediate oxygen radicals in the coordination sphere of iron ions was shown.

An important place, in the author's opinion, should be given to the use of magnetic particles (as sources of MF) as biologically active substances of a new class. It should be noted that today there is not enough information regarding the use of magnetic particles of iron and compounds based on it, compounds of rare earth elements, etc. In particular, the use of highly dispersed ferromagnets for biomedical purposes is discussed in [13-17]. The use of particles of Fe203, metallic iron, Fe_30_4, etc. is described. The introduction of particles into the body depends on the dose of the substance, degree of dispersion, surface charge of particles, physicochemical stability, etc. [16, 34–37]. Reports [17, 38, 39] are devoted to the use of powders of metals Zn, Cu, Fe in colloidal form for the treatment of a number of pathological disorders, but without taking into account their biological activity. It should be noted that it is practically impossible to obtain stable suspensions of metals and to introduce them into the body in concentrations sufficient for an effective and long-term therapeutic effect. It can be assumed that one of the options for solving this problem is the introduction of metals into the body in the form of highly dispersed metal powders [17, 35–37]. The role of trace elements of metals in the life of living organisms is known [40, 41]. Their lack leads to disruption of the functioning of the body. These elements are required in very small quantities, there is a maximum concentration limit [42, 43].

Suspensions of magnetic particles [44–49] of two types are used for medical purposes: with a particle size of 0.01–0.1 and 1–10 μm. In this case, one should take into account the biocompatibility of magnetic fluids. The possibility of supplying and retaining drugs with the help of MFs created by magnetic fluids has been proven [25]. When solving these issues, much attention should be paid to magnetotherapy devices [50-53].

We [54, 55] for the first time obtained by the thermochemical method highly dispersed iron and composite powders of iron-silver, iron-platinum, iron-copper and iron-zinc, which are single magnets with high magnetic energy, with controlled physicochemical and medico-biological properties, without an analogue in world practice due to a special way of forming their particles. All properties are implemented simultaneously. Their effect on some biological objects has been studied, in particular, microorganisms [56], bacteria (Staphylococcus aureus and Pseudomonas aeruginosa) [57]. It was found that the obtained highly dispersed powders have a bactericidal effect, withstand sterilization temperatures up to 120 ± 10° C [58], are non-toxic (hazard class 4), corrosion-resistant [58], with a hydrophilic surface [60].

The influence of highly dispersed ferromagnets on biological objects is probably realized through chemical reactions proceeding according to a free radical mechanism (with the participation of oxygen, enzymatic reactions, many energy substrates, changes in the structure and properties of water, etc.).

The areas of application of highly dispersed ferromagnets have been experimentally established, for example, in the treatment of purulent wounds (trophic ulcers) [61], the thyroid gland [62], in oncology [63], neurooncology [64], etc.

Thus, it is shown in the work that the issues of the influence of MF and, in particular, MF, created by highly dispersed ferromagnets, on biological systems are of great theoretical and practical interest. This is confirmed by the significant experimental and clinical effects of MF.

Literature data and our own research testify to the diversity of the manifestation of the general reaction of living organisms to the impact of MF of various levels of tension, which indicates the involvement of numerous functional systems in it.

The possibilities of using MFs created by highly dispersed ferromagnets in solving many medical and biological problems have not been exhausted. This is, first of all, the study of mechanisms and the creation of a holistic theory of the biological effect of MF, the development of various kinds of composite materials for medical purposes.

Conclusion

Some published data and experimental results on the effect of the magnetic field of highly dispersed ferromagnets on biological systems are analyzed. The possibility of using highly dispersed ferromagnets for medical and biological purposes is shown.

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