

Mechanisms of the biological effect of the ELF_EMF

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Abstract

Introduction: Since 1990s, studies of the effects of Extremely-Low Frequency Electromagnetic Fields (ELF_EMF) on biological systems have been conducted, including investigation of the effects of these fields on cancer cell apoptosis and induction of calcium uptake in osteoblasts. Besides, the influence of the Earth's magnetic field on bird navigation has also been discussed. Since different effects have been observed on biological systems, providing mechanisms for these effects has become an essential line of research in Biophysics; Two of the likely mechanisms are Ion Cyclotron Resonance (ICR) and Radical Pair Mechanism (RPM). However, the criticisms on the ICR mechanism leaves the RPM the most plausible one so far.

Methods: Investigations indicate the influence of the Earth's magnetic field on the birds navigation, and the models that justify this phenomenon, present the effect this field on singlet/triplet transition states in the cryptochrome, which is in the photoreceptor neurons of these birds. The effect of ELF_EMF on calcium flux was investigated by measuring the amount of fluorescence light by fluorescence microscopy. The effect of these fields on the apoptosis of cancer cells was also studied by flow cytometry.

Results and discussion: Despite all the efforts, it seems that there is no mechanism to explain the effects of these fields on biological systems. However, the radical pair mechanism seems to be much more efficient to explain the effects of these fields than the ion cyclotron resonance.

Conclusion: Various effects had been observed, particularly the dependence of apoptosis level of cancer cells on the frequency of the applied field. Presenting a convincing explanation of these phenomena can be huge breakthrough and paves the way for employing ELF_EMF as a selective treatment for solid cancer tumors.

Keywords: ELF_EMF, Radical pair mechanism, Ion Cyclotron Resonance, Cancer cell

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