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Rotation of Simple Organic Systems Can Be Induced by Low Intensity Electromagnetic Fields

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ABSTRACT

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Biological systems have magnetic properties due to microscopic atomic dipoles in their compounds which align themselves individually if a magnetic field is applied. As a result, a biological system can align along the direction of an applied magnetic field following the theory of paramagnetism. This effect can be induced also in simple organic systems. For instance, the α-helix is the main structure of a protein. We should not be surprised by this effect as proteins α-helix has generally a relevant dipole moment which allows possible orientation of a protein along the direction of an applied electromagnetic field. For instance, hemoglobin has a dipole moment of 280 D [1]. Instead, what makes us wonder is the fact that this effect occurs even at very small intensity of an electromagnetic field regardless of its frequency. In order that this effect can be highlighted a sophisticated technique should be used, that is Fourier Transform Infrared (FTIR) spectroscopy.

FTIR spectroscopy can be considered as a valuable tool for analyzing the structure of proteins or other simple organic systems in aqueous solutions [2,3]. The use of this technique has evidenced a significant increase in intensity of proteins Amide I and Amide II vibration bands after exposure of typical proteins in water solutions to an electromagnetic field at a low intensity at 100mW/m2 in the range 0.9 – 2.5 GHz [4-7]. These vibration bands are characteristic of proteins secondary structure and are due above all to the α-helix content. Hence, an increasing of Amide I and II bands can be explained assuming that proteins α-helix aligned along the direction of applied electromagnetic field inducing an increasing

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of total amount of dipole moment. Typical proteins in bidistilled water solution were used in these experiments [4-6] in order to schematize cellular environment in which they are embedded. This effect was also observed in typical human cells [8-13]. Even this result should not surprise us because proteins α-helices are present in all types of cellular membrane channels [14-16]. In particular, cellular membrane protein accounting for about 50% of its mass forming the wall of cells channels [17].

Rotation induced by exposure to magnetic fields was also observed in DNA and chromosomes in neuronal-like cells. Indeed, significant decrease in intensity of the phosphate bands in the DNA infrared region was observed by FTIR spectroscopy after exposure of human neuronal-like cells to static and 50Hz magnetic field at the low-intensity value of 1mT [18]. This result can be explained assuming that uncoiling and unpackaging of chromatin constituents in chromosomes occurred after exposure, due to the torque induced by the applied magnetic field and the consequent chromosome alignment towards the direction of the field. Incidentally, the rotation of chromosomes produced by exposure to a magnetic field was observed directly by microscope of some plants, Allium sativum and Vicia faba, exposed to a magnetic field [18]. Also, this result depends on paramagnetic property of DNA constituents. However, these results seem that cannot be explained theoretically. In fact, Adair showed that the torque of an electromagnetic field at high intensity is lower than the mean angular momentum due to thermal molecular agitation in organic matter [19].

Nevertheless, it was shown that the impulse from an electromagnetic field integrated over an interval of some hour will overhead the mean angular momentum from thermal agitation [20], demonstrating that the torque induced by high frequency electromagnetic field from wireless devices can affect organic matter due to the duration of exposure. Indeed, the simulation of Adair can be applied to a macrodipole exposed to an electromagnetic field provided that the viscous damper of the medium in which it is embedded can be neglected, for instance in the vacuum. In contrast, organic systems are embedded in aqueous solutions with viscous damper that cannot be neglected. As a result, the macrodipole cannot follow the oscillation of the electromagnetic field due to the inertia of molecules and the viscosity of the medium, so that it will place itself at an average position along the direction of the field [7]. Hence, the entire exposure time should be taken into account in the calculation of the torque induced by an applied electromagnetic field so that the simulation is in agreement with experimental results.

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