

Action Mechanism of Electromagnetic Fields on Cells. A pathway to Cell Death

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According to our theory on the mechanism of action of electromagnetic fields on cells, [Panagopoulos et al 2000; 2002; Panagopoulos and Margaritis 2003], which is considered until now as the most valid one from all the proposed theories, [Creasey and Goldberg, 2001], even very weak low frequency electric fields of the order of 10^{-2} V/m, are theoretically able to change the intracellular ionic concentrations. This is due to the fact that any external oscillating electric or magnetic field, induces forced-vibrations on the free ions that exist in large concentrations within and outside of all cell membranes. When the amplitude of this forced-vibration exceeds some critical value, the electrostatic force exerted by the oscillating ions' charge on the electric sensors of voltage-gated membrane ion channels, can irregularly gate these channels, resulting to changes of intracellular ionic concentrations. In the case of high frequency-microwave fields, whenever these fields are pulsed or modulated on low frequencies as happens in the most cases like in mobile telephony radiations, again our theory explains successfully the biological action of these radiations. As is well known, the low frequency pulses on digital mobile telephony radiations are necessary for the transmission of information by these signals and therefore they are intimately bound with the nature of these radiations.

The changes of intracellular ionic concentrations especially calcium, can lead to cell death either through apoptosis or necrosis, [Santini et al. 2005]. A common event preceding cell death, is the increase of mitochondrial calcium ion concentration released by endoplasmic reticulum, [Armstrong 2006]. The mitochondrial concentration of calcium ions can be increased by irregular uptake due to direct action of the external field on calcium channels of the mitochondrial membrane, or indirectly due to increased calcium release in the cytoplasm by endoplasmic reticulum membrane or by plasma membrane. Cell death induction, as it was shown in recent experiments of ours, is the reason for the decrease in the reproductive capacity of insects caused by mobile telephony radiations and power line fields, [Panagopoulos et al 2007]. Since an external oscillating field or wave can irregularly change the intracellular ionic concentrations by inducing ionic forced-vibration, it is able under certain conditions to lead to cell death. Thus it can be explained according to our theory the induction of cell death by mobile telephony radiations, found in recent experiments.

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