The enhanced proliferation of cells in culture and the stress effects upon higher plants induced by sinusoidal-varying low frequency electromagnetic fields are suppressed by radical scavengers (Session K02)

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In previous publications we reported that sinusoidal varying magnetic fields(SVMF) induce the following changes in chick embryo fibroblasts (CEF):fluidization of the plasma membrane, modify the activity and enhances the rotational dynamics of the malignancy marker adenosine deaminase which is bound to the membranal adenosine deaminase complexing protein (ADCP=CD26=DPPIV)and enhance CEF proliferation. The changes in membrane dynamics were characteristics to those observed in malignant viral(RSV) cell transformation. While the SVMF examined by us (50, 60 & 100 Hz /0.06 - 0.7 mT) were all below kT, they may have the potential of altering chemical processes in which excited radicals are involved. In some photochemical reactions performed at 1.0 mT magnetic field, a mechanism of "radical solvent cage dissociation and recombination" was suggested: the energy gap between the excited triplet vibraional sublevel - triplet-zero and singlet states depends on weak magnetic fields, the Zeeman splitting effect. Since singlet radical pairs will recombine within a solvent cage more readily than triplets, triplet radical pairs stand a better chance of escaping from the solvent cage in which they are initially formed. This will result in a different radical-recombination-product profile. The energy gap between the singlet and triplet excited radicals in the proposed hypothesis of solvent caged radical pair calls for magnetic field intensities similar to those reported here.We tested this hypothesis in two experimental systems: CEF in culture and Spirodela oligorrhiza (Lemnaceae) (a small aquatic plant,known as Duckweed). CEF were exposed to SVMF of 100 Hz / 0.7 mT for 24 h. The addition of the exogenous radical scavengers catalase,
superoxide dismutase or vitamin E, to the cells during the exposure, significantly suppressed the enhancement in cell proliferation caused by the field (by 79%, 67% and 82%, respectively, as evaluated by the MTT colorimetric assay). 15N NMR analysis of Duckweed plants fed by 15N-labeled ammonium chloride and exposed to SVMF at 60 and 100 Hz / 0.7 mT for 24 h, revealed augmented alanine production.
Alanine did not accumulate in the absence of SVMF. The addition of vitamin C, a radical scavenger, reduced alanine production by 82%. Exposure to SVMF resulted in specific metabolic stress effects in Duckweed plants and enhanced proliferation of CEF. In both cases a linkage between the magnetic field and free radicals is suggested. Inhibition of the SVMF enhanced cell proliferation and modified amino acid metabolism by radical scavengers provide experimental observations in line with the radicals hypothesis, in which excited radical pairs within a solvent cage could be affected by the low magnetic field employed. A Zeeman like effect may alter the spin state population through interaction with the SVMF employed.