Weak Magnetic Fields Effects on Biological Systems

Frank Barnes University of Colorado Boulder

Abstract

There has been a controversy over the possible health effects of weak electric and magnetic fields from sources such as power lines and cell phones for many years. This controversy has been elevated by the difficulty in obtaining reproducible results and the lack of a generally accepted mechanism by which biological systems can be modified by electric fields that are small compared to those across membranes or magnetic fields such that the energy associated with changes in the orientation of a molecular magnetic dipole are small compared to the thermal energy.

In this paper it will be shown that magnetic fields on the order of micro-Tesla can change the concentration of radicals such as super oxide, O_2^{-*} and nitrous oxides, NOx and molecules such as hydrogen peroxide, H_2O_2. These molecules are both signaling molecules and can damage molecules such as lipids and DNA in high concentrations and can lead to ageing, cancers, and Alzheimer's for long term exposures. A theoretical basis for changing the recombination lifetime of radical which in turn leads to changes in concentrations will be presented. Experimental results that show changes in both radical concentrations and in the growth rate of fibrosarcoma and of fibroblast cells for exposures to static magnetic fields ranging from less than 1μT to 200μT will be presented. Data on both the inhibition of cellular proliferation and enhancement of hydrogen peroxide production in fibrosarcoma cell line by RF magnetic fields of 10μT in the range from 5 to 10MHz will be presented.

Biological systems have many feedback and repair processes so that under many exposure conditions adverse health effects are not observed. The reasons why health effects may be seen, under other conditions, will be discussed. Biological data indicates that long term increases in radical concentrations can lead to resetting of the base line levels for radical concentrations such as reactive oxygen and nitrous oxides which, in turn, are associated with changes in membrane voltages, ageing, cancer, and Alzheimer's.