Evidence for Biological Effects of RF at Low Exposures

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Abstract

The safety standards for exposures to RF fields are set on the basis of thermal heating at levels sufficiently low so that adverse health effects are not expected. These standards are the result of extensive studies on both animals and epidemiological work. The exposure limits are a function of frequency and typically lead to specific absorption rates of less than 1.6 W/kg. However, there are a number of experiments that show changes in the behavior of biological systems that are unlikely to be associated with changes in temperature. In this paper we will review a number of papers that report biological effects under conditions for which changes in temperature are unlikely to be important.

This work will include experiments from our lab showing changes in both direction and speed for exposures of neutrophils (a class of white blood cells) on microscope slides [Aly 2008]. Work by [Barteri 2005] that has shown that the exposure to RF radiation from cell phones operating from 915MHz to 1822MHz for 20 minutes or more at a maximum electric field intensity of 12 V/m and a corresponding SAR of 0.5 W/kg can lead to the monomerization of acetylcholinesterase obtained from an electric eel and a reduction in the chemical reaction rate for acetylcholine hydrolysis. The temperature change was less than 0.2 ^{o}C. Low-level changes have been shown in the heat shock proteins for exposures to 900MHz at an average SAR of 2 W/kg for 1hr. [Leszczynski 2002] Low levels of microwaves at 9.4GHz (1µs, 1000pps) with an average incident power of 30µW/cm^2, and SAR 0.015 W/kg amplitude-modulated at 14-40MHz has been shown to both increase and decrease the antibody response in mice as a function of the modulation frequency. [Veyret 1989] The possibility that these effects may be the result of changes in free radical concentration induced by radio frequency transitions between singlet and triplet states of chemically excited molecules will be discussed and is supported by results showing that fields of 100µT may change electron-hole recombination rates in the frequency range from 1- 80 MHz. [Woodward 2001, Stass D. 2000]

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