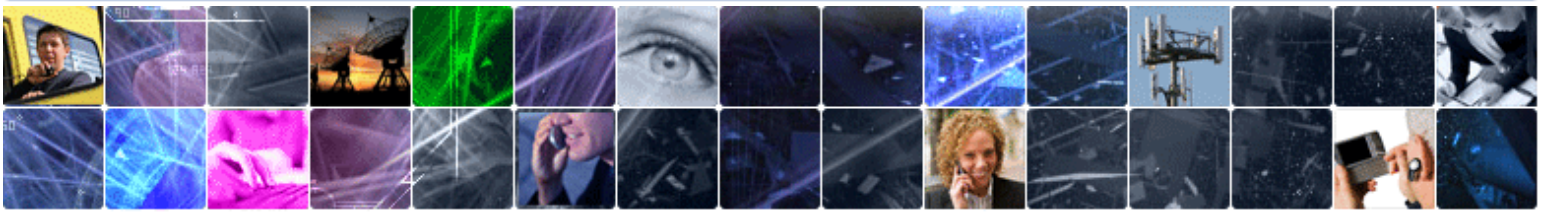

Research - Laboratory

Authors

Blank M, Goodman R. **DNA is a fractal antenna in electromagnetic fields.** Int. J. Radiat. Biol., 84:4, 409-415, 2011.

Background
The electromagnetic spectrum encompasses a wide range of frequencies, and can be divided into two broad classes: ionising and non-ionising radiation (See link for electromagnetic spectrum range and wave frequency). Non-ionising radiation includes extremely low frequency (ELF) that transmits electricity to power electrical appliances etc., and radiofrequency (RF) used in communication devices. The different frequencies emitted from these devices have varied near exposure distances based on their wavelength. For example, ELFs have wavelengths several kilometres in length so that everything for a wide range is considered to be in the near field of exposure. In comparison, RF frequencies of 1 GHz have shorter wavelengths and the near field of exposure is approximately 3 cm. As a result, public concern demanding research on health related effects due of different type of exposure from the wide range of EM radiation is not unfounded. This study investigates how the structural properties of DNA allow it to absorb a wide range of frequencies and how this could translate into DNA strand breaks and an increase in the levels of stress proteins.
Objective
One objective of this study was to investigate whether DNA has the properties of a fractal antenna and can receive EM at several different frequencies at the same time. Another objective was to review the literature and determine whether different frequencies of EM affect DNA structure and increase stress protein levels.

Methods
Published reports and papers were examined to determine:

1. Level of strands breaks in DNA due to different non-ionising EM frequencies and increased amounts of stress protein production
2. Properties of DNA and it ability to act as a fractal antenna

Results
The results were summarized under two broad categories:

1. Studies in non-ionising range
    1. Many studies have analyzed health effects associated with low frequency range (power lines and electrical appliances) and have found that the stress response is activated. DNA strand breaks are associated with fields strengths that are higher than those that initiate the stress response. Chronic low level exposure has been associated with childhood leukemia.
    2. EMF exposures in the RF range have been associated with brain and salivary gland tumours.
2. DNA as a fractal antennal
    1. A fractal antenna is an antenna that can receive and transmit electromagnetic radiation at many different frequencies simultaneously. Eukaryotic DNA can act as a fractal antenna due to is structural properties and interact with a wide range of frequencies at the same time.
    2. DNA can be activated in both the non-ionising and ionising range and this could lead to breaks in the DNA strands depending on the amount of energy that is absorbed. The higher the frequency, the greater the energy absorbed, and the higher contribution to DNA damage.

Discussion
The authors believed that if DNA acts as a fractal antenna and can interact with a wide range of frequencies simultaneously then safety standards

based on individual frequency range is insufficient. They believe the same mechanism occurs when DNA interacts with any frequency across the EMF spectrum and safety standards should instead be based on a biologically-based safety standard that would take into account the cumulative effect of all EMF frequencies.

The authors also speculated that early evolution was driven by mutations caused by ionising radiation and the fractal properties of eukaryotic DNA increased the probability that mutations would occur.

Conclusions
The unique structure of eukaryotic DNA allows it to act as a fractal antenna and simultaneously interact with a wide frequency range within the EMF spectrum. This has several advantages and disadvantages. The advantage is through spontaneous DNA mutation, the process of evolution to occur at a higher rate creating many more plant and animal species. Disadvantages include the increased rate of mutation also increases the rate of cancer epidemiology.

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