

Stress protein synthesis: EMF interaction with DNA
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Abstract

The cellular stress response is the enhanced synthesis of stress proteins that is activated by potentially harmful physical (e.g., temperature) and chemical (e.g., pH) changes in the environment. It is also activated by EMF. Research on the stress response has led to important insights into the biological EMF interaction mechanism:

- Since the stress response is a protective mechanism, it should be clear that cells react to EMF as potentially harmful.
- Activation of the stress response by both (non-thermal) power frequency and (thermal) radiofrequency EMF shows that the biological response is not simply related to the EMF energy. Protective biological responses occur at EMF thresholds that are far below thermal levels.
- Protein synthesis requires activation of DNA, and analysis of the DNA code for a stress protein gene shows two different DNA segments in the gene promoter, one for a specific EMF response to low energy stimuli, and another for high energy thermal stimuli. The EMF-specific DNA segments can be activated by EMF when they are coupled to other genes.
- Studies of enzyme reactions show that EMF accelerate electron transfer rates. The interaction with electrons suggests that EMF interaction with DNA could involve the delocalized electrons of the base pairs. The chemical properties of the EMF-specific DNA segments support a direct effect of EMF on DNA. Also, the stimulation of muscle protein synthesis *in vivo* is an example of this mechanism in action in a natural process. The electric fields of the muscle action potentials activate the DNA in muscle nuclei prior to contraction.
- Cancer is believed to be initiated by damage to DNA, so the low levels of EMF that activate DNA in the stress response, and the destructive DNA strand breaks that are reported at higher EMF, provide a molecular rationale for the increased risk of various cancers associated with extended exposure.

Research on the effects of EMF on DNA underscores the need for greater precaution in setting safety standards. The permitted ELF and RF levels should be approximately 3 orders of magnitude lower than present levels, as advocated by the online Bioinitiative Report (2007) and re-emphasized in the special issue on EMF in the journal *Pathophysiology* (2009).