Low Frequency (LF) Electric Field Effects On Gene Expression

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We evaluated the effects, on cultured human SaOS-2 cells, of exposures to the low frequency (LF) electric signal (60 kHz sinusoidal wave, 24.5 V peak-to-peak voltage, amplitude modulated by a 12.5 Hz square wave, 50% duty cycle) from an apparatus of current clinical use in bone diseases requiring regenerating processes. Cells in flasks were exposed to a capacitively coupled electric field (CCEF) giving electric current density in the sample of 4 μA/cm². The whole expressed cellular mRNAs were systematically analyzed by “DNA microchips” technology to identify all individual species quantitatively affected by the field exposure. Comparisons were done between RNA samples from exposed and control sham-exposed cells. Results indicated that immediately and 4 hours after exposure there were almost no differentially modulated mRNA species. However, samples obtained at 24 hours after exposure showed a small number of limitedly differential signals (7 down-regulated and 3 up-regulated with a cut-off value of ±1.5, 38 and 11 respectively with a cut-off value of ±1.3), which included mostly mRNA encoding transcription factors and DNA binding proteins. Nevertheless, in identical experimental conditions, we previously demonstrated enzymatic changes of alkaline phosphatase occurring immediately after exposure and declining in few hours. Therefore, since enzymatic changes occur before than those observed at gene regulation level, it is conceivable that only earlier effects are directly due the treatment and then these effects are later able to affect only indirectly gene expression.