Evaluating The Cell Cytotoxicity Of Electromagnetic Wavelength Emitted By Cell Phones And Wi-fi On HEK-293 Cell

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Introduction

Cell phones and Wi-Fi routers have become an invaluable part of people's lives around the globe. As of 2014, the United States had more than 327.5 million cell phone subscribers. With a population of only 325 million, over 90% of people in the United States have at least one or more cellphones. As cell phone and Wi-Fi users steadily increase, many have begun to question the safety of these tiny yet powerful machines. The main concern involving devices like these is the radiofrequency electromagnetic radiation (RF- EMR) they emit. Mobile phones today emit anywhere between 450 and 2700 MHz (Isabona and Srivastava 2017), while Wi-Fi router can go up to 5000 MHz (5 GHz).

Along with the FDA 's Radiation Control provisions efforts, many researchers in the scientific community have attempted to assess the cytotoxicity of RF-EMR emitted by cellphone and Wi-Fi. The purpose of this experiment is to see if the electromagnetic radiation similar to the amounts emitted by cell phones and Wi-Fi routers could have cytotoxic effects on HEK-293, a neuron-like cell. In this study the effect of RF-EMR is evaluated on the cellular viability and cell growth.

Materials and Methods

Cell Culture:
The HEK-293 cells were used in this research. The cells were cultured in DMEM high glucose medium containing 10% FBS and 1% PSG using 35mm dishes and 24 well plates.

Exposure System:
The exposure system is a RF generator that is capable of creating waves between 34 Hz to 4400 MHz, attached to a portable power source and an antenna.

Cell Viability Assays:
Trypan Blue and MTT assays were used to evaluate cellular viability. Trypan Blue is used as vibrant stain to selectively color dead cells blue. MTT is a colorimetric assay which uses mitochondrial activity to access viability. MTT solution is reduced to Formazan in healthy cells and becomes purple dye. Cells were plated so 24 hours later they would be 70-80% confluent at the time of treatment. 24 hours after plating, cells were treated for 24 hours with various doses of RF-EMR (1.5, 2.0, and 2.5GHz). After the treatment, the cells were allowed to recover for 24 hours. To perform MTT assay, the MTT dye (5mg/ml) was added to the plate, and incubated for 3 hours at 37℃ incubators with 5% CO_2. Following incubation the media was removed, and the samples were solubilized in buffer (0.1M HCl in IPA). Plates were read at 570nm and the data was used to analyze the amount of viable cells present. To perform Trypan Blue Assay, after 24 hours of recovery, 50 uL of cell suspension were mixed with 50 uL of Trypan Blue. The blue (dead) and clear (live) cells were then counted using a hemocytometer.

Results

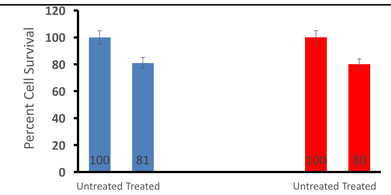

Figure 1. Effect of 2.5GHz radiation on 400K Cells (Blue) and 200K Cells (Red) when comparing untreated vs treat cells. K=1000 cells

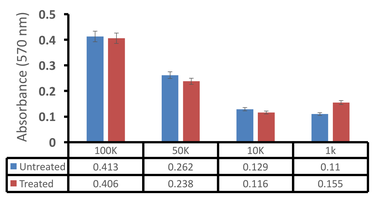

Figure 2. MTT Assay results for 2.5 GHz radiation comparing the untreated vs treat cells. 1K=1000 cells

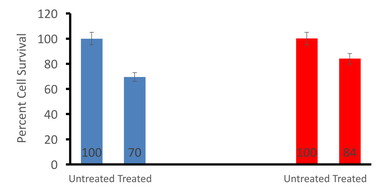

Figure 3 Effect of 2.0GHz radiation on 400K Cells (Blue) and 200K Cells (Red) when comparing untreated vs treat cells. 1K=1000 cells

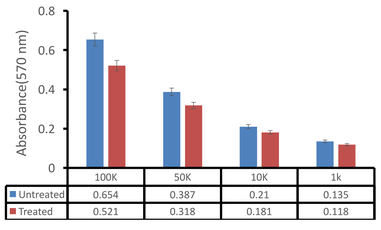

Figure 4 MTT Assay results for 2.0 GHz radiation comparing the untreated vs treat cells. 1K=1000 cells

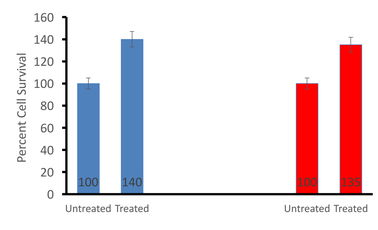

Figure 5 Effect of 2.0GHz radiation on 400K Cells (Blue) and 200K Cells (Red) when comparing untreated vs treat cells. 1K=1000 cells

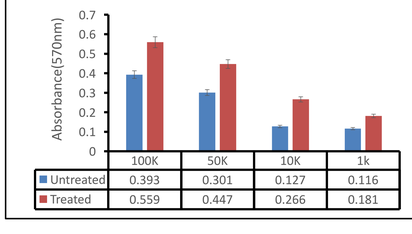

Figure 6 MTT Assay results for 2.0 GHz radiation comparing the untreated vs treat cells. 1K=1000 cells.

Conclusions and Future Research

- Results of cell counting post RF-EMR treatment suggests that the HEK-293 cells in plates that were exposed to 2.0 and 2.5 GHz grew less confluent compared to untreated cells. This indicates cell phone and Wi-Fi EMR at these frequencies appear to have a cytotoxic affect on these cells.
- Conversely cells that were exposed to 1.5 GHz grew to be more confluent compared to untreated cells. Interestingly, this indicates cellular EMR at these frequencies promote cellular proliferation.
- The results from MTT assay suggest that plates containing cells exposed to frequencies of 2.0 and 2.5 GHz had lower viability compared to untreated cells.
- Inversely plates that were exposed to 1.5 GHz grew to be more viable when comparing the treated vs. untreated.
- Future experiments includes repeating all the assays several times using various cell lines to verify the data and evaluate other cells responses. Furthermore, continued research will be conducted to explore what caused some cells to die at 2.0 and 2.5 GHz and to study the molecular mechanism underlying this observation.

References

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