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Inhibition of MCF-7 cell-line proliferation using broadband electric fields

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2018

https://hdl.handle.net/10539/26371

Malan, Keagan Ryan (2018) Inhibition of MCF-7 cell-line proliferation using broadband electric fields, University of the Witwatersrand, Johannesburg, https://hdl.handle.net/10539/26371

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Abstract

The aim of this research was to determine whether the efficacy of Tumour Treating Field therapy could be improved using broadband electric fields instead of the single-frequency treatment currently being used. A customised, low-impedance experimental set-up was designed, simulated, constructed and used to deliver the broadband electric fields to cultured cells from the MCF-7 cell-line in an *in vitro* environment. The experimental set-up used a Nunc Lab-Tek Chamber Slide system that had been adapted using four 3D-printed parts and a customised gasket. Enamelled copper wires with bare diameters of 0.100 mm were used to deliver the electric fields in cell cultures containing both two wires and eight wires. Each wire was located 1 mm away from adjacent wires in the cell culture. The simulations were performed using FEKO and showed that a 2 V excitation placed on adjacent wires resulted in a minimum electric field intensity of approximately 4 V/cm between the wires. This matched analytical predictions within 36 %. Treatment was performed for 24 hours and the results were quantified with a resazurin-based dye assay. The results showed that, with the voltages used, there were no significant and repeatable differences between the broadband treatment and the optimal single-frequency treatment. However, as the results from both of these treatments were similar to those of the untreated controls, it is suspected that the voltages used were too low to generate the electric field intensities required to inhibit the proliferation of the MCF-7 cells. Future work can be done in repeating these experiments using higher voltages, in repeating them for other cell-lines, and in characterising the frequencies of sensitivity for other cell-lines and their non-cancerous counterparts.