Study of Irreversible Electroporation of Potato Tissue by EIS Spectroscopic Analysis With the Aim of Optimizing Pulse Protocol Testing Methods for Cancer Treatment

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Irreversible electroporation (IRE) is an innovative technique that disrupts cellular homeostasis, functioning similarly to non-thermal apoptosis. This method enables the selective ablation of cancer cells while preserving surrounding healthy tissues. Considering the lack of empirical evidence regarding the efficacy of pulse parameters for plant tissues, this study aims to analyze the similarities between IRE protocols in human and plant cells. We conducted experiments using thin slices (1-2 mm) of potato placed between two flat electrodes made of gold-plated copper, mounted on polymer plates. EIS was used to obtain Nyquist and Bode plots for the slices before and after applying an electrical pulse protocol (50-200 V, 5-15 pulses, 50-200 microseconds, 1 Hz), enabling a direct comparison with existing data on human tissues. Additionally, we examined the bluish coloration in electroporated samples. Results indicated that variations in pulse amplitude and the number of applied pulses influenced impedance values, suggesting a positive correlation between electroporation intensity and these factors, along with the observed bluish color. Conversely, pulse duration did not correlate with the electroporation of plant tissues. We observed that the trends in plant tissues were similar to those in human tissues, the only difference being the absolute values. Our study establishes a direct relationship between the behavior of vegetal tissues subjected to IRE and that of human tissues exposed to analogous techniques. Consequently, this method may be utilized to investigate new pulse protocols for treating specific malignant tumors, providing a cost-effective and time-efficient means for researchers to preliminarily assess the effects of electroporation on human tissue.

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