Examining the Potential of Selective Bacterial Lysis through Pulsed Magnetic Fields at the Resonant Frequency of the Escherichia coli Cell Membrane

Harmon, Joshua (School: Camdenton High School)

Current methods of bacterial disinfection are unsuitable due to high cost and inability to kill microbes without altering the product composition. Pulsed magnetic field technology offers potential promise as a disinfectant for many applications; however, research related to this process has not discovered the mechanism causing cell lysis, inhibiting commercialization. The purpose of this study was to determine whether magnetic fields can be pulsed at the resonant frequency of the Escherichia coli (E. coli) cell membrane, potentially identifying the mechanism by which pulsed magnetic fields influence cell death. Resonant circuits were created to subject bacterial samples to pulsed magnetic fields in order to test for cell death. Treatment groups subjected E. coli to the hypothesized resonance frequency (63.7 kHz), 50 kHz, and 80 kHz then compared the bacterial concentrations for each group to the untreated bacterial samples in colony forming units (cfu). Additionally, Citrobacter freundii was tested to ensure that this treatment selectively affects E. coli at the hypothesized resonant frequency. E. coli exposed to pulsed magnetic fields at the hypothesized resonant frequency resulted in a cfu level reduction of 3 logs when compared to the control and subsequent frequencies tested ($p=.003$). C. freundii colony counts were not adversely affected. This study represents the first successful attempt to utilize pulsed magnetic fields at bacterial resonant frequencies to promote bacterial mortality, potentially allowing for disinfection of specific pathogenic or saprophytic bacteria without adversely impacting the rest of the medium.

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