Title Radio frequency electric fields inactivation of *Escherichia coli* in apple cider

Author David J. Geveke and Christopher Brunkhorst

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Abstract

A nonthermal process using radio frequency electric fields (RFEF) was developed to pasteurize apple cider. An 80 kW RFEF pilot plant system was used to process cider at flow rates of 1.5 and 1.9 l/min. *Escherichia coli* K12 in apple cider was exposed to electric field strengths of 20–30 kV/cm at frequencies of 21, 30, and 41 kHz. Treatment times varied from 140 to 420 μs. Electrical energy costs were calculated using the measured voltages and currents. Energy balances were performed using the inlet and outlet temperatures. RFEF processing at an outlet temperature of 60 °C reduced the population of *E. coli* by 4.8 log, whereas thermal processing at the same conditions had no effect. Varying the frequency between 21 and 41 kHz had no effect on the level of microbial inactivation; however, increasing the treatment time, field strength and outlet temperature enhanced inactivation. The inactivation data at 20 kV/cm and 60 °C follow first order kinetics with a calculated *D* values of 74 μs. The inactivation data are represented well by the electric field strength model; the calculated critical electric field strength, E_c, for 60 °C was 4.0 kV/cm. The electrical energy for RFEF pasteurization was 260 J/ml. The electrical cost was $0.0050/l of apple cider. Processing temperature had the greatest influence on energy efficiency. A RFEF nonthermal process has been developed to pasteurize apple cider. The effect of varying processing conditions on energy efficiency was investigated and at the optimum condition, the electrical cost appears to be minor. In addition, the RFEF process can be correlated using first order kinetic models.