Accelerated Inactivation of Bacterial Spores by Interaction of Electric Fields with Key Spore Components

SINGH S. (1), ALI M. (1), KORZA G. (2), SETLOW P. (2), SASTRY S. (1)
1 The Ohio State University, Columbus, United States
2 University of Connecticut Health, Farmington, United States

Prior work shows that the electrical components of ohmic heating (OH) cause accelerated inactivation of bacterial spores. In this work we explored the effects of electric field strength on the inactivation of *Clostridium sporogenes* PA3679 (a surrogate of *Clostridium botulinum*), and *Bacillus subtilis* PS533 (wild-type) & PS578 (lacking Small Acid-Soluble Proteins: SASP). Matching the temperature history is crucial for comparing the thermal and ohmic treatment: we used a specialized apparatus that allowed us to achieve that goal. In this study we allowed the temperature to rise linearly by applying a constant electric field, and once the samples reached the set temperature, they were immediately cooled i.e., with zero holding time. We conducted experiments with three field strengths (30, 40, and 50 V/cm), and three final temperature settings (95, 105, and 115oC for *B. subtilis*, and 110, 120, and 130oC for *C. sporogenes*) respectively. Our results show that field strength had a strong effect on the inactivation of both spores, for instance the reduction in *C. sporogenes* counts increased from 1.71±0.06 CFU/ml for 30 V/cm to 3.9±0.52 CFU/ml for 50 V/cm at 130oC. Similarly, for *B. subtilis*, the inactivation increased from 1.72±0.04 to 4.94±0.28 CFU/ml at 115oC. We compared the inactivation data of ohmic with that of conventional heating by matching the temperature histories and we found a significant difference between ohmic and conventional. Furthermore, results of tests with spores of *B. subtilis* that lacked SASPs suggest that SASPs are one of the targets of the electric field. These findings add to our understanding of the nonthermal effects of OH and highlight the potential of OH to be used as an efficient way to kill spores without significantly affecting product quality.