Title	Cold Atmospheric Pressure Plasma Reduces *Listeria innocua* on the Surface of Apple
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Abstract

Fresh produce can be contaminated with bacterial pathogens, leading to increased risk of foodborne illness. High energy plasma discharges effectively inactivate bacteria on inert surfaces, and have potential application to fragile surfaces such as fruits and vegetables. A novel technology, the gliding are plasma discharge apparatus, allows the deposition of a cold atmospheric pressure plasma (CAPP) onto surfaces through the use of forced air, thereby reducing the potential for excessive heat or spot damage to the surface. Golden delicious apples were spot inoculated with approximately 8 log CFU of the non-pathogenic surrogate *Listeria innocua* in log growth phase. On separate sets of apples, the spot was left untreated (control) or treated with one of two levels of CAPP discharge. In the first ("Low"), the discharge amperage was set to 115 mA, placing the CAPP discharge height approximately 1 cm away from the apple surface, and the treatment lasted for 2 min. In the second ("High") the discharge amperage was set to 150 mA, placing the plasma discharge in full contact with the apple surface, and the treatment lased for 4 min. The voltage was held constant at 10.02 kV. Separate sets of inoculated apples were treated with either 2 or 4 min of forced air with no CAPP discharge. Apple surfaces were sampled with sterile swabs and phosphate buffer, serially diluted and plated on PALCAM agar. There were no significant ($P < .05$) differences in *L. innocua* recovery among the control, Air-2 or Air-4 treatments, which had 4.29, 4.36 and 4.42 log CFU, respectively. The CAPP treatments significantly reduced the recoverable *L. innocua* by 0.39 log CFU in the case of "Low", and by 1.10 log CFU in the case of "High". The apples were examined for gross changes in color and appearance at the site of treatment immediately after treatment, and after 2 and 5 days in storage at 8°C. No changes were observed. These results suggest that CAPP may be an effective treatment for the reduction of microbial populations on fragile produce surfaces.