Optimization of Atmospheric Cold Plasma Device for Food Decontamination

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Current Decontamination Methods

Method

- Chlorinated water
- Microwave
- Radiation
- Infra-red
- Chlorine dioxide
- Electrolyzed oxidizing water
- Organic Acids

- Dense Phase CO2
- Pulsed- light system
- Ozone

Limitation

- Effects on texture & color
- Lacks consumer appeal
- Heats food quickly
- Produces small amounts of toxic by-products
- Water needs continuous electrolysis & H+, HOCL & Cl2
- Very dependent of concentration, pH of environment and the acid used
- Expensive equipment and large temperature range
- Only clear packages
- Does not react with water

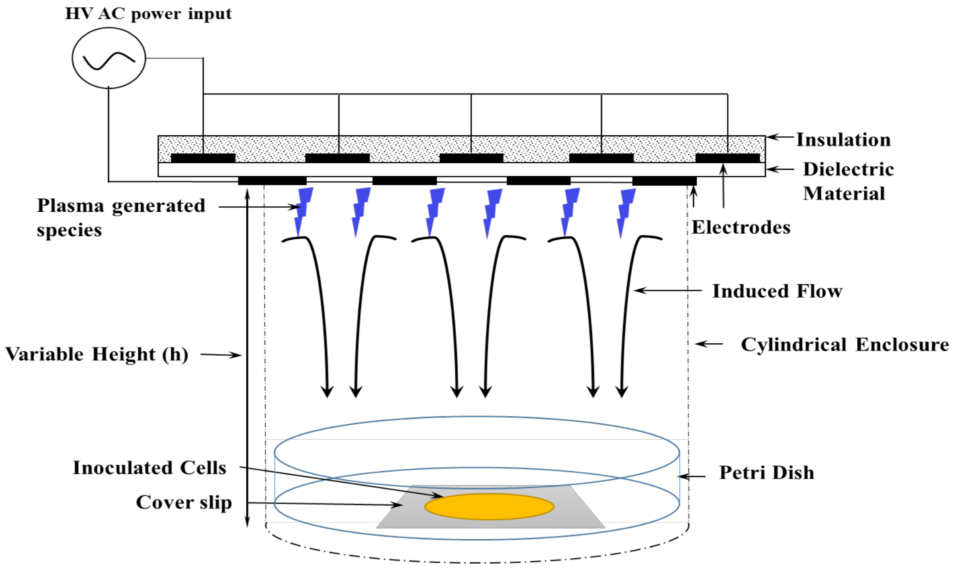
Atmospheric Cold Plasma

- Uses electricity, atmospheric air and actuator to produce plasma
- Has strong oxidizing properties
- Dry, non-thermal, low cost to set up
- Treatment efficiency depends on
    - Distance
    - Time
    - Power available to machine
    - Electrode width
    - Gap width between electrodes
    - Generating pulse

OBJECTIVE

- To assess the impact of electrode arrangements on the inactivation of foodborne pathogen by ACP
- To investigate the influence of power input and pulsing intervals on the inactivation of foodborne pathogen by ACP

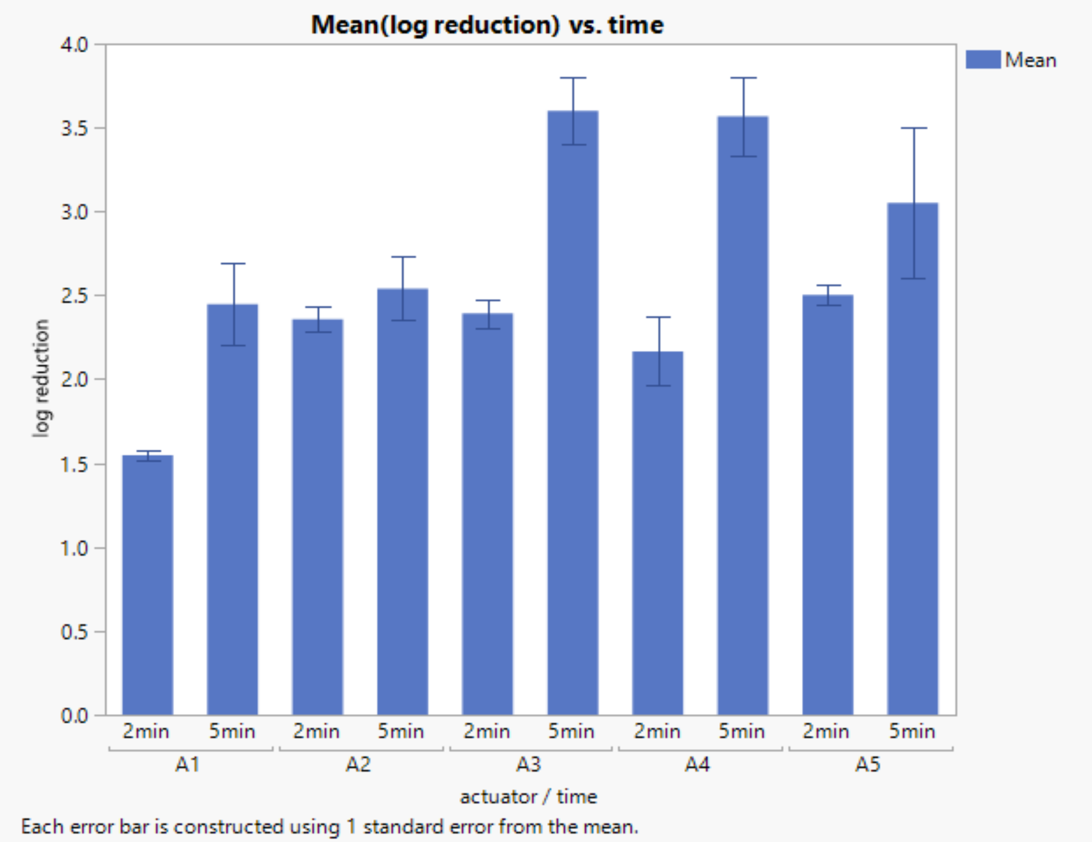
METHODOLOGY



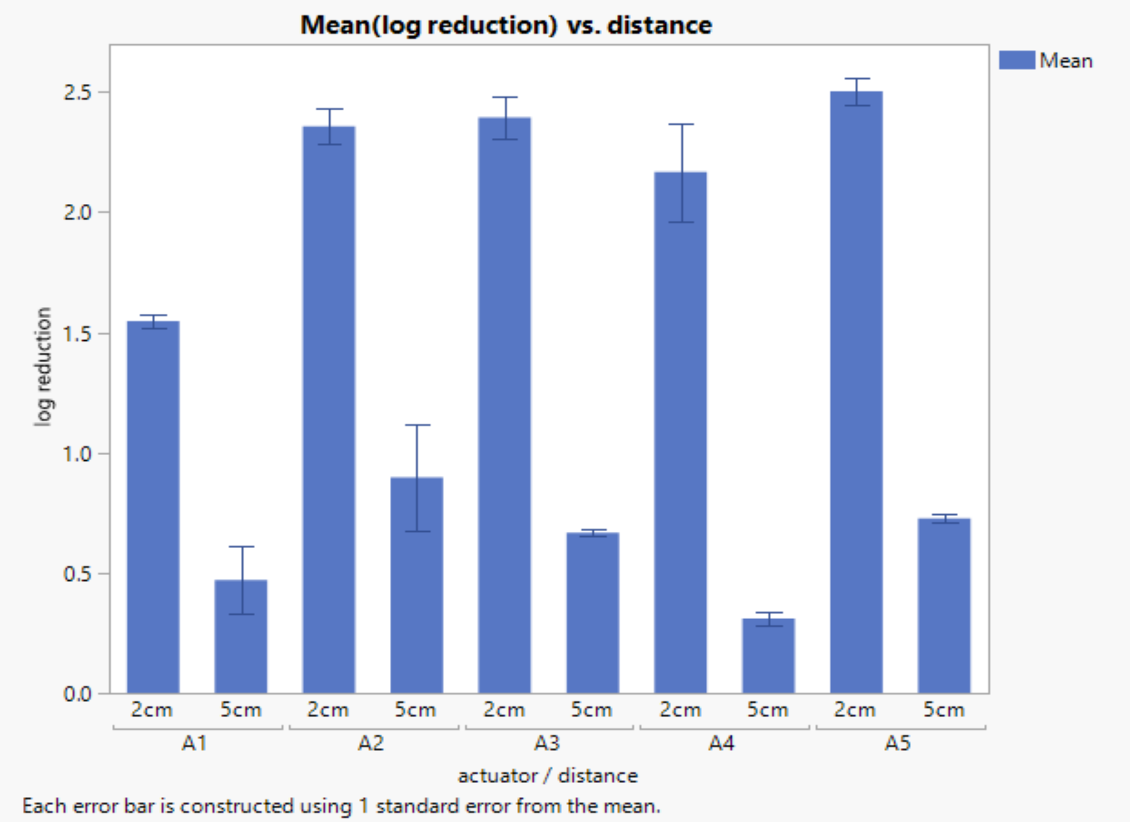
Asymmetric SDBD CAP (Timmons et al. 2017)

- Sterile glass coverslips was spot inoculated with a 5-strain mixture of *Salmonella enterica*
- Air-dried for 1 hour before treatment
- Treated at 2 cm distance for 2 & 5min and 5 cm distance for 2 & 5 min
- Washed in sterile 0.1% peptone and dilutions plated
- Enumeration & log reduction calculations
- Variables
  - Electrode width
  - Gap between electrodes
  - Treatment time
  - Distance of item from actuator

RESULTS



Each error bar is constructed using 1 standard error from the mean.



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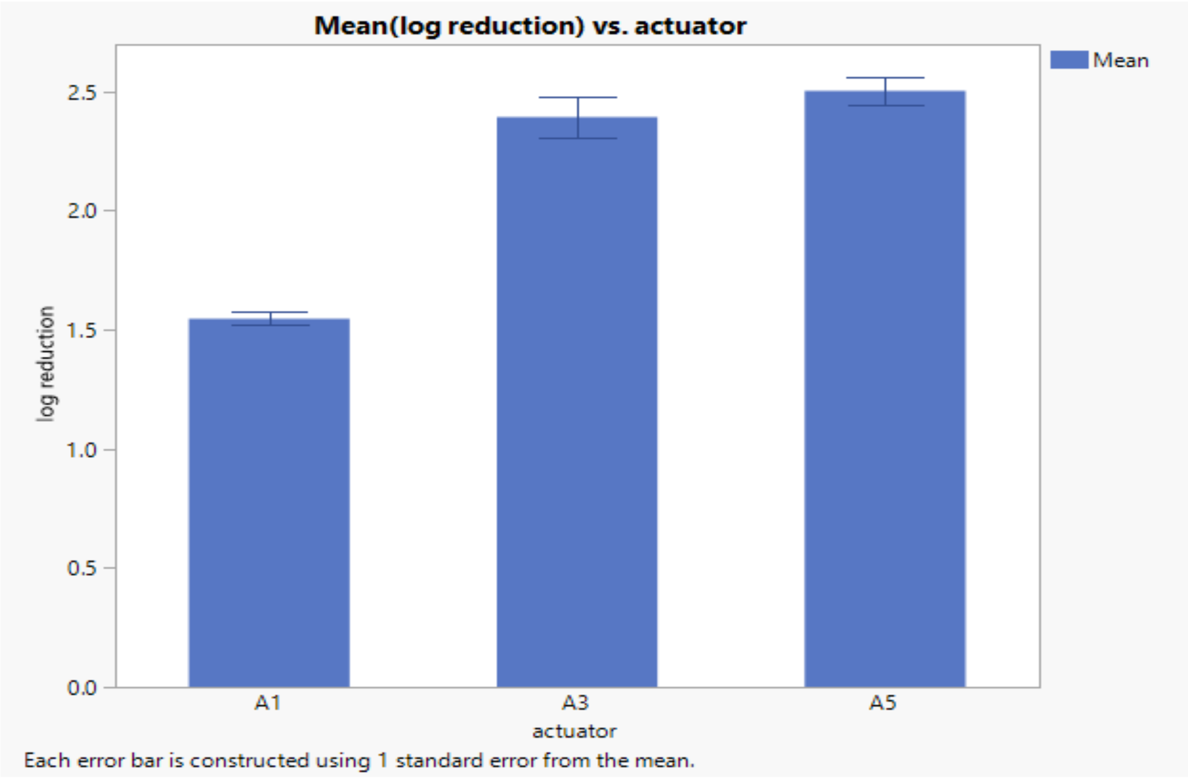
- Cell counts were converted to log values and log reductions
- Wilcoxon sign rank test p-value of 0.0003, the 2cm 5min was best overall for log reduction

RESULTS



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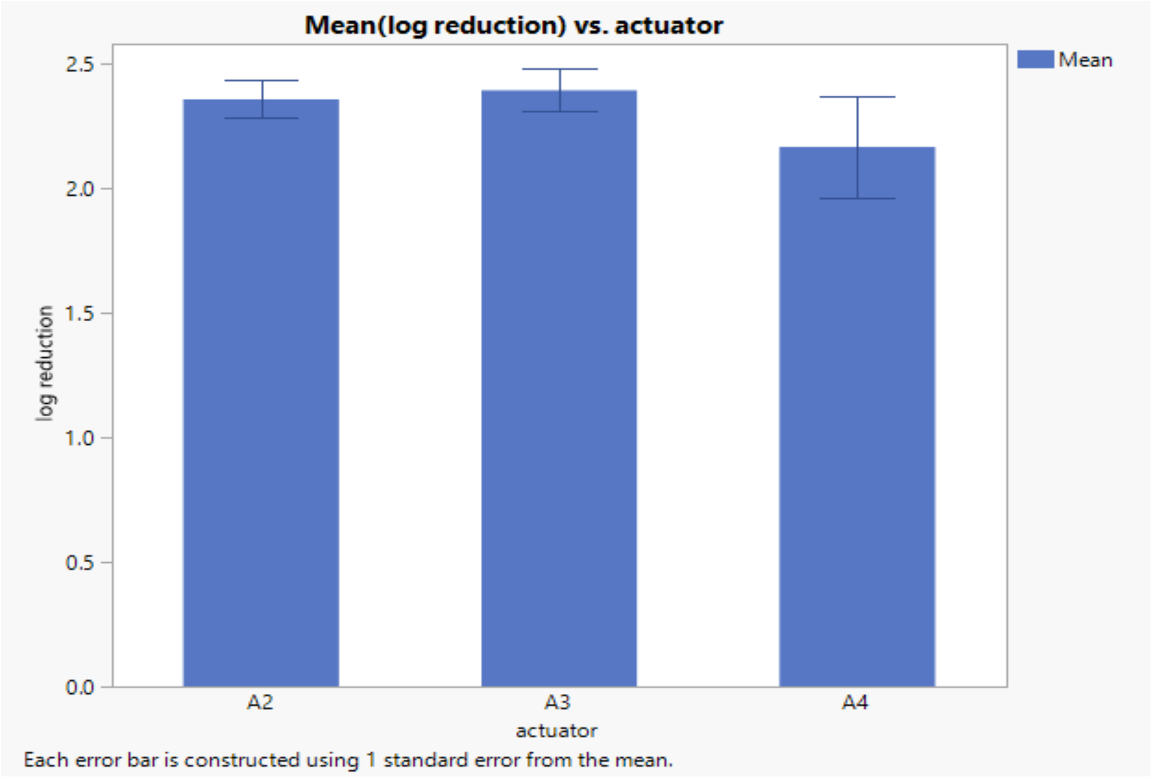

Each error bar is constructed using 1 standard error from the mean.

- The actuators were compared from the 2 min 2cm using ANOVA
- Electrode gap (Left) is the same for A1, A3 & A5. A3 & A5 both had a p-value <0.0001
- Electrode width (Right) is the same for A2, A3 & A4. All had a p-value above 0.05

Summary

- Longer treatment time and shorter treatment distance result in higher log reduction among all actuators
- Electrode width at and above 0.5 cm improves inactivation efficiency significantly
- No significant difference in inactivation efficiency among electrode gaps at 0.1, 0.5, and 1.0 mm
- Next, we will look at operational parameters
  - Power input
  - Pulse interval