Published April 25, 2019

2018 Reciprocal Meat Conference – Meat and Poultry Safety

Meat and Muscle Biology™

Antimicrobial Effects of Peroxyacetic Acid Acidified with Various Acids when Applied to Inoculated Prerigor Beef Carcass Surface Tissue

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Keywords: antimicrobial intervention, beef, escherichia coli
Meat and Muscle Biology 2(2):133 **doi:10.221751/rmc2018.118**

Objectives

Two studies were conducted to evaluate the antimicrobial effects of blends of peroxyacetic acid (PAA) acidified with various acids against inoculated populations of nonpathogenic *Escherichia coli* biotype I surrogates for pathogenic *E. coli* and *Salmonella* on warm, prerigor beef carcass surface brisket tissue.

Materials and Methods

In phase I, 10 × 10 cm pieces (n = 10) of warm, prerigor beef carcass surface brisket tissue were inoculated (6 to 7 log CFU/cm^2) with a 5-strain mixture of nonpathogenic *E. coli* biotype I surrogates. Samples were either left untreated (control) or were immersed for 10 s in PAA (400 ppm) acidified with lactic acid (3.5%), PAA (400 ppm) acidified with acetic acid (2%), PAA (400 ppm) acidified with citric acid (1%), PAA (400 ppm) acidified with a sulfuric acid and sodium sulfate blend (pH 1.2 and pH 1.8; SSS), and PAA (300 ppm) acidified with SSS (pH 1.2). All samples were analyzed 5 min post-treatment for surviving *Enterobacteriaceae* populations. In phase II, 10 × 10 cm pieces (n = 10) of prerigor beef tissue inoculated (6 to 7 log CFU/cm^2) with the same 5-strain mixture of nonpathogenic *E. coli* surrogates were either left untreated or were spray-treated (10 s) with water, PAA (350 ppm), PAA (400 ppm), PAA (400 ppm) acidified with acetic acid (2%), PAA (400 ppm) acidified with SSS (pH 1.2), or PAA (350 ppm) acidified with SSS (pH 1.2). Untreated and treated beef tissue samples were analyzed 5 min post-treatment for *E. coli* counts. Data were analyzed using the lsmeans package in R (Rstudio, 2015, Boston, MA) with antimicrobial treatment (including surfactant treatments) as the independent variable. Least-squares means were separated using a significance level of $\alpha = 0.05$.

Results

All immersion treatments evaluated in phase I effectively ($P < 0.05$) reduced inoculated *E. coli* populations on the prerigor beef carcass surface tissue by at least 2.3 log CFU/cm^2. The 400 ppm PAA treatments acidified with lactic acid, SSS (pH 1.2), or acetic acid were the most ($P < 0.05$) effective treatments, lowering inoculated bacterial counts from 6.2 log CFU/cm^2 to 3.4, 3.4, and 3.7 log CFU/cm^2, respectively. In phase II, all of the tested antimicrobial spray treatments effectively ($P < 0.05$) lowered initial inoculated *E. coli* counts (6.4 log CFU/cm^2) by 1.7 to 1.9 log CFU/cm^2. No ($P \geq 0.05$) differences in efficacy were observed between the 5 antimicrobial treatments.

Conclusion

Since acidifying PAA with acetic acid or SSS is comparable to utilizing PAA, this could provide the industry with alternative antimicrobial intervention systems. Alternating the use of antimicrobials in a multiple-hurdle system could aid in the prevention of antimicrobial resistance.

