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Reduction of Salmonella in Post-Harvest Hot Carcass Pork Using Multiple Interventions

A. N. Orange[1]*, M. M. Brashears[1,2], M. F. Miller[1], and A. Echeverry[1]

[1]Animal and Food Science, Texas Tech University, Lubbock, TX, 79409, USA; [2]International Center for Food Industry Excellence, Texas Tech University, Lubbock, TX, 79409, USA
*Corresponding author. Email: ashley.n.orange@ttu.edu (A. N. Orange)

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Objectives

Salmonella continues to be a leading cause of morbidity due to foodborne illness in the United States, accounting for 11% of the total annual foodborne illness cases (> 1 million) as well as 35% of hospitalizations and 28% of deaths related to foodborne disease. Pork is known to carry *Salmonella*, and it is critical that interventions be validated in simulated industry settings to effectively demonstrate the reductions of this pathogen. The purpose of this study was to determine the efficacy of various FSIS approved interventions on the reduction of *Salmonella* on post-harvest hot carcass pork.

Materials and Methods

Fresh pork skin, that was warmed and held at pre-rigor temperatures of 37°C, was inoculated with a 5-strain cocktail of Rifampicin Resistant *Salmonella* strains (*S.* Newport T1–473, *S.* Typhimurium R1–089, *S.* Enteritidis T1–496, *S.* Montevideo 11TTU382B, and *S.* Anatum 11TTU158B). Pork samples were dipped into a *Salmonella* solution of 7.00 Log_{10} CFU/ml for a final concentration of 5.00 Log_{10} CFU/cm^2 on the pork surfaces. Interventions tested in this study included: 1) Sulfuric acid and sodium sulfate (pH 1.3), 2) peracetic acid (350 ppm), 3) lactic acid (3%), 4) citric acid (1.3%), 5) hypobromous acid (300 ppm), and 6) lauramide arginine ethyl ester (200 ppm), 7) peracetic acid (400 ppm) with 2% acetic acid, and 8) sulfuric acid and sodium sulfate (pH 1.3) combined with peracetic acid (350 ppm). Treatments were prepared according to manufacturers' recommendations to desired concentrations and confirmed using a pH meter, chemical titration and test kits specified for each intervention chemical prior to treatment of the pork meat. A commercial CHAD cabinet (CHAD Equipment LLC., Olathe, KS) was used to apply treatments held at ambient temperature (21°C) at a speed of 30.4 cm/2.5 sec at a pressure of 257.8 kPa. *Salmonella* on the pork was enumerated before treatments, and 5 min and 24 h after treatment. *Salmonella* was enumerated on Tryptic Soy Agar modified to have a concentration of 100 mcg/mL of rifampicin within the agar solution. Each experiment was replicated 3 times and statistically analyzed using ANOVA and pairwise *t* tests.

Results

To measure significance, a *P*-value of 0.1 was used during statistical analysis. Five-min post treatment *Salmonella* reductions showed significant reduction with the application of lauramide arginine ethyl ester with a 1.31 Log_{10} CFU/cm^2 reduction ($P = 0.006$) and hypobromous acid with a 1.66 Log_{10} CFU/cm^2 reduction ($P = 0.07$). *Salmonella* reductions 24 H post treatment showed significant reductions with the application of hypobromous acid (2.06 Log_{10} CFU/cm^2 reduction; $P = 0.07$), sulfuric acid and sodium sulfate (1.81 Log_{10} CFU/cm^2 reduction; $P < 0.001$), sulfuric acid and sodium sulfate combined with peracetic acid (1.73 Log_{10} CFU/cm^2 reduction; $P < 0.001$), and lauramide arginine ethyl ester (1.56 Log_{10} CFU/cm^2 reduction; $P < 0.001$).

Conclusion

It is pivotal for the industry to validate the efficacy of antimicrobial interventions to demonstrate that the process achieves pathogen reductions. The results of this study indicate that the application of a hypobromous acid, sulfuric acid and sodium sulfate, sulfuric acid and sodium sulfate combined with peracetic acid or lauramide arginine ethyl ester as an intervention significantly reduces *Salmonella* in pork from initial inoculated loads.

