EFFECTS OF 3% ACETIC ACID ON *SALMONELLA* REDUCTION IN PORK TRIMMING

D. Sajeev[1*], P. Anderson[1], C. Dahlgren[1], H. Thames[2], C. Fancher[2], A. Sukumaran[2], S. White[3], J. Feugang[1], O. Rivers[4], W. Schilling[3], and T. Dinh[1],

[1]*Department of Animal and Dairy Sciences, Mississippi State University, Mississippi State, MS*,

[2]*Department of Poultry Science, Mississippi State University, Mississippi State, MS*,

[3]*Department of Food Science, Nutrition, and Health Promotion, Mississippi State University, Mississippi State, MS*,

[4]*Institute for Imaging and Analytical Technologies, Mississippi State University, Mississippi State, MS, USA*,

*ds2823@msstate.edu

I. OBJECTIVES

The objective of the current study was to determine the efficacy of dipping pork trimmings in 3% acetic acid on *Salmonella* reduction.

II. MATERIALS AND METHODS

Pork loins and trimmings were purchased from a commercial purveyor. Pork loins were trimmed, leaving only the *longissimus* muscle, which was further cut into 2.5 cm (length) × 2.5 cm (width) × 1.3 cm (height) cubes. Pork trimmings were further ground through a kidney plate to approximately 2-in cubes and aliquoted into 5-lb chubs. To study the effects of temperature and time on efficacy of 3% acetic acid in reducing *Salmonella*, pork cubes were inoculated at 5 log of nalidixic acid–resistant *Salmonella serovar* Typhimurium and randomly assigned to the negative control (no inoculation, no dipping), a positive control (inoculation, no dipping), acetic acid dipping at 21°C (ACC), and acetic acid dipping at 50°C (ACH) for 15, 45, or 75 s. To study the efficacy of 3% acetic acid at 50°C in reducing *Salmonella* inoculated at the geometrical center of pork trimming bulks, a pork cube inoculated at 5-log cocktail of nalidixic acid–resistant *Salmonella serovar* Typhimurium and *Salmonella serovar* Enteritidis was placed at the geometrical center of a 2.5-kg pile of other uninoculated cubes in perforated canisters to create a simulation of a trimming bucket in the industry. Treatments were randomly assigned to a negative control (no inoculation; no dipping), a positive control (inoculation; no dipping), 3% acetic acid dipping at 50°C without (ACH), or with shaking (ACHS) for 75 s. After both experiments, pork cubes were retrieved and placed in Buffered Peptone Water for Salmonella extraction and plated in Xylose Lysine Deoxycholate agar for enumeration, reported as log CFU. A 9-log culture of nalidixic acid–resistant *Salmonella enterica* serovar Typhimurium was also treated with 3% acetic acid at 50°C for 45 or 75 s and observed by scanning electron microscopy and transmission electron microscopy for structural damages. A completely randomized design was used. Analysis of variance was performed by the GLIMMIX procedure of SAS version 9.4 (SAS Institute Inc., Cary, NC).

III. RESULTS

For 15-s dipping, ACH reduced *Salmonella* by 0.7 log ($P < 0.001$), 0.5 log greater than ACC ($P < 0.001$). For 45-s dipping, ACH reduced *Salmonella* by 1.0 log ($P < 0.001$), 0.7 log greater than ACC ($P < 0.001$). For 75-s dipping, the *Salmonella* reduction by ACH treatment was 1.4 log ($P < 0.001$), whereas the reduction was less for ACC treatment ($P = 0.004$), at only 0.5 log ($P < 0.001$). ACH treatment reduced *Salmonella* in the geometrically centered cubes by 0.2 log ($P = 0.040$). The ACHS treatment similarly ($P = 0.198$) reduced *Salmonella*

by 0.3 log ($P = 0.010$). The scanning electron microscopy images showed a less rigid surface of treated cells than the positive-control cells, especially for 75-s treatment. Moreover, transmission electron microscopy images revealed structural damages inside the treated *Salmonella* cells and the disappearance of the cell membrane of the treated cells, especially for 75-s dipping.

IV. CONCLUSION

The present study suggests that acetic acid at 3% and 50°C for 75 s reduced *Salmonella* by 1.4-log by disrupting the bacterial cell membrane. Large bulks of pork trimming did not allow for adequate penetration by acetic acid solution. It is recommended to spread trimming on conveyor or loosen trimming bulks to allow for adequate penetration by acetic acid.

Keywords: acetic acid, pork trimmings, *Salmonella* reduction, scanning electron microscopy, transmission electron microscopy