EFFECTS OF BACTERIOPHAGES AND PEROXYACETIC ACID APPLICATIONS ON BEEF CONTAMINATED WITH *SALMONELLA* DURING DIFFERENT GRINDING STAGES

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I. OBJECTIVES

Previous research has suggested that lymph nodes in beef trim may be a source of *Salmonella* and therefore a potential contamination source that is incorporated into ground beef. Before grinding, beef trim is usually treated with antimicrobials to reduce risks of pathogen contamination. In this study, we tested the efficacy of bacteriophage (PhageGuard S [PGS]) and peroxyacetic acid (PAA) applications on contaminated trim, coarse ground, and fine ground beef (final ground product) to directly evaluate potential *Salmonella* reduction at different grinding steps.

II. MATERIALS AND METHODS

Rose meat (m. *cutaneous trunci*) was fabricated into trim-like pieces and assigned to 120-g samples ($n = 36$), coarse ground (4 mm, $n = 36$), or coarse ground followed by fine ground (2 mm, $n = 36$). Samples ($n = 108$ total) were randomly assigned to a 3×4 factorial design including fixed effects of grinding stage (trim, coarse, fine) and treatment (Control, 400 ppm PAA, 50% PGS, 5% PGS) with 9 observations each. Nested models for each grinding stage were also tested. Samples were inoculated with a 4-Salmonella-strain cocktail to achieve 2 × 104 colony-forming units (CFU)/g. After 30 min of bacterial attachment at 5°C, samples were treated with 1,200 µL of either sterile buffered peptone water (Control), 400 ppm PAA, 50% PGS (1 × 109 plaque forming units/g), or 5% PGS (1×10^8 plaque forming units/g). After treatment, samples were hand massaged through sterile foil and allowed to dwell for 6 h at 5°C prior to grinding (for trim and coarse samples). After grinding, samples dwelled for 22 ± 2 h at 5°C. Subsequently, a 10-g aliquot was stomached for 2 min at 230 rpm in Buffered Peptone Water. The homogenate was serially diluted before plating on Xylose Lysine Deoxycholate agar and Aerobic Plate Count (APC) Petrifilm plates. Plates were incubated at 35°C for 24 h, and typical colonies were counted. APC plates were incubated for 48 h at 35°C. Data were analyzed using SAS as a completely randomized design (SAS Institute Inc., Cary, NC).

III. RESULTS

No interaction between both fixed effects was observed ($P = 0.37$). The same was true for grinding stage effect ($P = 0.29$). Treatment effect was significant at $P < 0.0001$. Overall, a significant decrease of approximately 1.5 log was observed when comparing Control samples (3.6 log CFU/g) to 50% PGS (2.10 log CFU/g) treatments and a significant 0.8 log reduction for 5% PGS (2.79 log CFU/g). When analyzing nested models for trim, coarse, and fine ground, the greatest reductions were seen with trim application by 5% and 50% PGS resulting in 1.13 and 1.29 log CFU/g, respectively. For coarse, only applications of 50% PGS significantly reduced *Salmonella* (1.59 log), whereas for fine, 50% PGS led to the optimal reduction (1.67 log). Overall, similar *Salmonella* loads were observed for Control and PAA-treated samples (3.60 and 3.53 log, respectively. Grinding stage and treatment effects individually affected mesophilic counts. Ground products had higher APC counts compared to trim, whereas bacteriophage applications led to lower APC counts compared to PAA.

IV. CONCLUSION

Application of bacteriophages at any grinding stage reduce *Salmonella* when compared to PAA. When applied onto trim, simulating surface contamination, the lower concentration of phages promoted similar reduction compared to the higher concentration. In comminuted stages simulating possible lymph node contamination, higher concentrations of bacteriophage solutions provided the best results.

Keywords: bacteriophage, ground beef, *Salmonella*