Ensured beef microbial safety is of vital importance to avoid food-borne pathogenic outbreaks. Hence, the meat industry is continuously seeking new and effective decontamination techniques. Electrostatic spray systems may allow efficient utilization of antimicrobials in meat decontamination technology. Therefore, effectiveness of different antimicrobial electrostatic spray applications on Longissimus lumborum at the sub-primal level on microbial quality and instrumental color of beef steaks during display was evaluated. Longissimus lumborum muscles (n=12) were cut into 3 subsections (n=36) and inoculated with Escherichia coli (EC; ATCC # 11775) and Salmonella Typhimurium (ST; ATCC # 1769NR) at 10^7 CFU/mL. The inoculated subsections (n=36) were then sprayed with: (1) water, (2) 10% trisodium phosphate (TSP), (3) 3% potassium lactate (KL), (4) 0.4% cetylpyridinium chloride (CPC), (5) 20% hydrochloric/citric acid mixture (CIT), or kept as (6) untreated inoculated control; or (7) un-inoculated untreated control before being cut into 2.5 cm thickness steaks (n=15/treatment). The steaks were then placed on foam trays with absorbent pads, overwrapped with polystyrene film. Steaks from each treatment were removed from display for bacterial enumeration of EC, ST, coliform (CO), aerobic plate count (APC), and instrumental color analysis on days 1, 3, and 7. The hydrochloric/citric acid mixture had the greatest (P <0.05) reduction in EC compared to CPC, KL, TSP, and water (6.02 vs. 7.50, 7.30, 7.93, and 7.63 respectively.) All treatments significantly reduced all bacterial counts when compared to the inoculated control. The CIT, CPC, and KL treatments had no significant differences (P >0.05) for lightness (L*), redness (a*), yellowness (b*), hue angle and saturation index properties compared to inoculated control steaks. The results suggest that the CIT treatment allowed for enhanced microbial quality. However, further studies should be conducted to evaluate effectiveness in combination with other antimicrobials on sensory characteristics of red meat.

Introduction

Outbreaks of foodborne illnesses have caused product recalls and loss of revenue for processors and have negatively affected the consumer perception of beef.

The meat industry currently evaluates decontamination techniques such as utilization of antimicrobial treatments.

Electrostatic spray systems may allow efficient utilization of antimicrobials in meat decontamination technology.

Objective

The effectiveness of antimicrobial interventions through electrostatic spray application on Longissimus lumborum at the sub-primal level on microbial quality and instrumental color of beef steaks during display was evaluated.

Conclusion

The CIT treatment surpassed the KL, CPC, TSP, and water treatments in reducing bacterial counts. Electrostatic spray application of other treatments at the sub-primal level of Longissimus lumborum may reduce microorganisms on steaks through three days of display. An added benefit is that these treatments may not affect L*, a*, and b*.

Materials and Methods

Bacterial preparation and inoculation

Escherichia coli (ATCC # 11775; EC) 0.1 mL.

Salmonella Typhimurium (ATCC # 1769NR; ST) 0.1 mL. Incubated in Brain Heart Infusion Agar (40 mL) at 37°C for 18 hours.

The inoculum was centrifuged 3500 x g for 20 min at 37°C. Re-suspended in 40 mL 0.1% Buffered Peptone.

The bacterial cocktail (EC and ST log 10^7 CFU, 3600 mL) stored at 4°C.

Beef Longissimus lumborum (n=11) were inoculated with the bacterial cocktail and placed in a 4°C cooler for 12 to 14 hours to allow for further attachment.

Antimicrobial Treatments

Longissimus lumborum subsections (n=3/treatment) were sprayed with an electrostatic spraying system (3ml/sec/60psi)

Steaks were overwrapped with polystyrene film and stored in simulated retail display at 4°C.

1630 lux of delux warm white fluorescent lighting.

3. Sample Analysis

Instrumental color characteristics were measured by Hunter Miniscan XE, with the Illuminant A and 10 observer.

Properties for L*, a*, b*, hue angle and saturation index were evaluated on days 1, 3, and 7.

Least squares means were generated for all variables and separated using the PDIFF option of SAS.

Sampled on day 1, 3, and 7 as described by Pohlman et al., 2009.

Spread plating in duplicates: Aerobic plate count (APC), E. coli (EC) / coliform (CO) counts on Petrifilm®.

ST plating was performed on Difco Salmonella Agar.

Bacterial values were transformed to log values and least squares means were generated for all variables and separated using the PDIFF option of SAS.

Treatments

- INCON = untreated inoculated control
- CONTROL = untreated uninoculated control
- W = water
- TSP = 10% trisodium phosphate
- CPC = 0.4% cetylpyridinium chloride
- KL = 3% potassium lactate
- CIT = 20% hydrochloric / citric acid mixture

Results

Effect of antimicrobial treatment on least squares means log CFU* / g Coliform, Escherichia coli, Salmonella Typhimurium, and Aerobic Plate Count of beef steaks.

Effect of duration of display, pooled across antimicrobial treatments, on least squares means log CFU* / g E. coli, Salmonella Typhimurium, Aerobic plate count counts through simulated retail display.

Effect of duration of display, pooled across antimicrobial treatments, on least squares means log CFU* / g Escherichia coli, Coliform, Salmonella Typhimurium, Aerobic plate count counts through simulated retail display.

*CFU: colony forming units

abcd Least squares means within day with different superscripts differ (P < 0.05)