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Antimicrobial Effects of Lauric Arginate, Peroxyacetic Acid, and Buffered Sulfuric Acid against Pathogenic Bacteria Populations in Beef Trimmings Destined for Ground Beef

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Objectives

The objective is to find effective measures to control or inhibit growth of *E. coli* O157:H7, non-O157:H7 and *Salmonella* species in ground beef through exploring the effectiveness of antimicrobial properties of lauric arginate, peroxyacetic acid and buffered sulfuric acid, applied through an electrostatic spray system on inoculated trimmings.

Materials and Methods

Inoculums were prepared from frozen (–80°C) stock cultures of *Escherichia coli* O157:H7, O145, O121, O111, O103, O45, O26, and *Salmonella typhimurium* DT 104 and *newport* MDR-AmpC. *E. coli* was maintained by brain heart infusion (BHI) broth and *S. typhimuriuma* and *newport* were maintained by BHI broth containing nalidixic acid. The cocktail was pooled (420mL *E. coli* and 420mL *Salmonella* log 10^4 CFU/mL). The cocktail was hand mixed in a sterile bag with thawed beef trimmings and allowed to attach, then meat was drained and separated into 4 batches and placed in a cooler for 14 h. Inoculated beef trimmings were sprayed (~0.3 mL/g; 3 replicates/treatment) with either 5% lauric arginate (LA), 0.02% peroxacetic acid (PA) or buffered sulfuric acid (pH = 3; SA) and ground twice using a Hobart Grinder (3.2 mm plate) along with an unsprayed control (C). Ground beef was divided, packaged on stryofoam trays with absorbent pads overwrapped with polyvinyl chloride film and stored in a display case under retail conditions. 25 g microbial samples taken on display d 0, 1, 2, 3, and 5 were placed in sterile stomacher bags with 225 mL of 0.1% BPW and homogenized for 2 min. Serial 10-fold dilutions were done and plated on Petrifilm aerobic plate count (APC), EMB, and SS in duplicates. After 24 h of incubation (37°C), EMB plates were counted and after 48 h APC and SS plates were counted. Counts were converted to $\log_{10}$ and recorded as colony forming units per g of meat (CFU/g). Instrumental color was evaluated (CIE L*, a*, b*; 630/580 nm; hue angle; saturation index) on display d 0, 1, 2, 3, and 5 of simulated retail display using a Hunter Lab MiniScan EZ Spectrocolorimeter (A/10°). Analysis used MIXED procedure of SAS (SAS Inst. Inc., Carty, NC) in a 4 × 5 factorial arrangement with main effects spray treatment, display days and their interaction.

Results

The 3 treatments had no effect on APC ($P = 0.85$), *E. coli* ($P = 0.54$) and *Salmonella* ($P = 0.55$) growth. Display day had an effect ($P < 0.05$) on APC, *E. coli* and *Salmonella* growth. Display d 5 had increased growth for APC, *E. coli* and *Salmonella*, followed by display d 3, and 2. There was an interaction for APC with LA, PA and C having increased growth on display d 7 but SA had decreased growth on display d 5. There was also an interaction for *E. coli* growth with LA, PA, and C having increased growth on display d 5 but SA had decreased growth on display d 5. PA and SA treatments were darker (lower L*; $P < 0.05$) than LA and C treatments. PA and SA treatments were redder (greater a*; $P < 0.05$) than LA and C treatments. Hue angle was greater ($P < 0.05$) for LA and C treatments compared to PA and SA. Chroma was greatest ($P < 0.05$) in SA and lowest in LA with PA and C being intermediate. PA and SA had the highest ($P < 0.05$) oxymyoglobin ratio followed by C and then LA.

Conclusion

SA was the only effective spray treatment but only by display d 5 for APC and *E. coli*. Spray treatments also have an impact on display color of ground beef.