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Validation of Antimicrobial Interventions Including the Use of 1,3-Dibromo-5,5-Dimethylhydantoin Applied in a Final Carcass Wash in a Commercial Beef Harvest Operation

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Objectives

A study was conducted to evaluate the ability of a bromine based antimicrobial (1,3-dibromo-5,5-dimethylhydantoin; DBDMH), applied in a final carcass wash, to reduce inoculated populations of nonpathogenic *Escherichia coli* biotype I, serving as surrogates for pathogenic *E. coli* and *Salmonella*, as well as natural microflora on beef carcasses in a commercial beef harvest operation. Additionally, the cumulative decontamination efficacy of the DBDMH treatment and 3 subsequent interventions applied to beef carcasses was evaluated.

Materials and Methods

The inoculum consisted of a 5-strain mixture of *E. coli* biotype I. External carcass surfaces on the chuck were inoculated (6 log CFU/cm^2) within three 10 × 10 cm^2 zones using sponges hydrated with 10 mL of the inoculum; these served as samples before and after treatment with DBDMH and then following the complete intervention system. Additional zones remained uninoculated to test the treatment effect against carcass natural microflora. Twenty carcasses (10/d) received a low concentration DBDMH treatment (280 to 350 ppm; treatment 1) in a final wash cabinet as well as all of the remaining intervention treatments going into fabrication (lactic acid spray [LA; 2.0 to 2.5%], peroxyacetic acid spray chill [PAA; 300 to 400 ppm] and post-chill LA spray [2.0 to 5.0%]). A different set of 20 carcasses received a high concentration DBDMH treatment (550 to 630 ppm; treatment 2) in the final wash followed by all of the same subsequent intervention treatments. Carcass zones were sampled before and after treatment exposure with sampling sponges. Inoculated samples were analyzed for *Enterobacteriaceae* (EB) populations while uninoculated samples were analyzed for aerobic plate counts (APC) and EB counts. The study was designed as a paired comparison replicated on 2 d, with day serving as a random variable. Surviving bacterial populations were analyzed using the Mixed Procedure of SAS (SAS Inst. Inc., Cary, NC); data were expressed as least squares means with differences reported using a significance level of $\alpha = 0.05$.

Results

Carcasses treated with 280 to 350 ppm DBDMH in the final wash cabinet and subsequent interventions prior to fabrication reduced ($P < 0.05$) initial EB counts of 6.0 log CFU/cm^2 to 4.8 and < 1.4 log CFU/cm^2, respectively (Table 1). Corresponding EB counts for carcasses that received the 550 to 630 ppm DBDMH treatment were 6.0 log CFU/cm2 before treatment, and 4.5 (after final carcass wash) and < 0.4 (after complete intervention system) log CFU/cm^2 following the antimicrobial treatments (Table 1). Surviving uninoculated APC and EB populations obtained from carcasses exposed to treatments 1 and 2 were less ($P < 0.05$) than initial populations obtained from beef carcasses prior to antimicrobial treatments. The surviving inoculated and uninoculated populations obtained from carcasses subjected to treatment 2 were lower ($P < 0.05$) than those subjected to treatment 1 (Table 1).

Conclusion

The use of DBDMH was effective at reducing inoculated and uninoculated microbial populations when applied as a carcass wash in a commercial beef operation, with the higher concentration being more effective. The series of interventions, including the use of DBDMH, LA and PAA, in a complete system was effective against inoculated and uninoculated microbial populations on beef carcasses in a commercial beef harvest operation.

Table 1. Adjusted least squares (LS) mean *Enterobacteriaceae* plate counts (log CFU/cm^2; [standard error]) for inoculated beef carcass zones before (untreated control) and after (treatments 1 and 2) application of antimicrobial interventions.

Treatment - Intervention	Untreated Control	DBDMH-Final Wash	Complete Intervention System[1]	% BDL
1 – DBDMH	6.0^a	4.8^b	< 1.4^c	22.5
(280 to 350 ppm)	(0.5)	(0.5)	(0.5)	
2 – DBDMH	6.0^a	4.5^b	< 0.4^c	47.5
(550 to 630 ppm)	(0.4)	(0.4)	(0.4)	
Contrast *P*-Value	N/A	< 0.0001	< 0.0001	N/A

DBDMH: 1,3-dibromo-5,5-dimethylhydantoin.

$^{a, b, c}$ LSMeans bearing different superscript letters within the same row are different from the control ($P < 0.05$).

LSMeans with a less than symbol (<) indicate at least one-sample was below the detection limit (< -0.6 log CFU/cm^2)

Contrast *P*-values < 0.05 are considered different within each column.

[1]Additional interventions included in the complete system: LA = 2.0% to 5.0%, PAA spray chill (300 to 400 ppm), and post-chill LA = 2.0% to 5.0%.

"N/A" indicates that the *P*-value was not calculated.

% BDL: indicates the percent of samples below the analysis detection limit after the complete intervention system.