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Assesment Of 1,3-Dibromo-5,5-Dimethylhydantoin as a Final Wash for Reducing Microbial Contamination on Beef Carcasses

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Objectives

The objective of this study was to evaluate the effect of a bromine-based antimicrobial (1,3-dibromo-5,5-dimethylhydantoin; DBDMH) in a food safety control system to eliminate hot water wash, against inoculated populations of *E. coli* biotype I surrogates on beef carcasses.

Materials and Methods

The surrogates consisted of a 5-strain mixture of non-pathogenic*E. coli* biotype I. The external surfaces of the carcasses were inoculated within 4 10 × 10cm areas. The inoculation level was approximately 6 log CFU/cm^2. Inoculated carcasses were allowed a 10 min attachment period. Three food safety systems were evaluated. On each sampling day, 3 inoculated carcasses (6 sides) received a hot water (HW; 204.8°F) wash and were sampled immediately. Carcasses then received a lactic acid spray treatment (3.8%), were sampled again, and chilled for 36h with a 10h DBDMH spray chill treatment (106.4 ppm) before the final samples were collected (A). A second set of 6 sides received a DBDMH (467 ppm) treatment in a final wash cabinet and were sampled immediately. Those carcasses received the same remaining interventions (lactic acid spray; DBDMH spray chill; B). The third set, another 6 sides received all interventions: DBDMH final wash, HW, lactic acid spray, and DBDMH spray chill (C). All 3 systems were repeated on a second production day. Inoculated samples were analyzed for *Enterobacteriaceae*(EB)populations. Appropriate dilutions were plated in duplicate to enumerate EB (3M Petrifilm Enterobacteriaceae) populations for all sponge samples. Colonies on EB Petrifilm plates were enumerated following 24-h incubation at 37°C. This study was designed as a randomized complete block, with production day serving as the block. Bacterial populations recovered were analyzed using the Mixed Procedure of SAS version 9.4 and data expressed as least squares means.

Table 1. Adjusted least squares mean *Enterobacteriaceae* plate counts (EB; log CFU/cm^2; [standard error]) for inoculated beef carcass zones before (Control) and after intervention treatments from systems A, B, and C (either a hot water wash [HW], a 1,3-Dibromo-5,5-Dimethylhydantoin final wash [DBDMH], or both [HW+DBDMH, respectively and the remaining interventions: Lactic Acid Spray and DBDMY Spray Chill).

System[1]	Control	HW, DBDMH, or HW+DBDMH	Lactic Acid Spray	DBDMH Spray Chill	% BDL[2]
A	6.6^{a} (0.3)	3.2^{b} (0.3)	3.0^{b} (0.3)	$< 1.2^{bx}$ (0.3)	25.0
B	6.6^{a} (0.3)	4.9^{b} (0.3)	4.8^{b} (0.3)	3.8^{by} (0.3)	0.0
C	6.6^{a} (0.3)	2.2^{b} (0.3)	2.2^{b} (0.3)	$< 0.5^{bz}$ (0.3)	33.3

$^{a, b}$ LSMeans bearing different superscript letters within the same row are different ($P < 0.05$) from the control (comparisons were not made between interventions, only to the control)
LSMeans with a less than symbol (<) indicate at least one sample within the treatment had counts that were below the detection limit (< -0.6 log CFU/cm^2)
$^{x, y, z}$ LSMeans bearing different superscript letters within the same column are different ($P < 0.05$) by direct contrasts
[1] Interventions included for each system: System A – HW, Lactic Acid Spray, DBDMH Spray Chill; System B – DBMH Final Wash, Lactic Acid Spray, DBDMH Spray chill; System C – HW+DBDMH, Lactic Acid Spray, DBDMH Spray Chill
[2] % BDL: indicates the percent of samples below the analysis detection limit after the complete intervention system

Results

The results for this study are found in Table 1. For system A, the HW reduced ($P < 0.05$) inoculated surrogate populations from 6.6 log CFU/cm^2 to 3.2 log CFU/cm^2. Additionally, following a lactic acid spray, the combined effect of the HW and lactic acid spray reduced ($P < 0.05$) the microbial populations to 3.0 log CFU/cm^2 and after DBDMH spray chill, the remaining populations were < 1.2 log CFU/cm^2. The initial inoculated surrogate populations were 6.6 log CFU/cm^{2}prior to application of system B (DBDMH final wash, lactic acid spray, DBDMH spray chill). Following DBDMH application in a final wash, surrogate populations were reduced ($P < 0.05$) to 4.9 log CFU/cm^2. The combined effect of the DBDMH final wash and the lactic acid spray treatment reduced ($P < 0.05$) the initial surrogate populations by 1.8 log CFU/cm^{2}and ultimately, after the DBDMH spray chill, the remaining surrogate populations were 3.8 log CFU/cm^2. Lastly, system C interventions (DBDMH final wash, HW, lactic acid, and a DBDMH spray chill) decreased ($P < 0.05$) initial populations from 6.6 log CFU/cm^2 to < 0.5 log CFU/cm^2. Overall, all systems were effective ($P < 0.05$) against the inoculated *E. coli* biotype I, surrogates for pathogenic *E. coli* and *Salmonella*, on beef carcasses.

Conclusion

In conclusion system C with all the intervention, provided the greatest potential for control against the inoculated *E. coli* biotype I surrogates when compared to the other 2 systems evaluated in this study.