Project Title: Using Critical Parameters to Ensure Efficacy of Selected Harvest and Fabrication Intervention Strategies Used to Control *Escherichia coli* O157:H7 and *Salmonella*

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Background

Food safety is a dynamic situation, and the beef industry continues to be criticized for contributing to foodborne illnesses. The Centers for Disease Control reported a decline in foodborne infections related to Shiga toxin-producing *Escherichia coli* (STEC) O157:H7, but an increase in *Salmonella* infections. These have been the two primary pathogens of concern in raw beef products, and today the non-O157:H7 STECs are added to the list of concerns. Pressure continues to be placed on establishments by the United States Department of Agriculture's (USDA) Food Safety and Inspection Service (FSIS) to improve their food safety programs which should then result in continued decreases in foodborne illnesses and product recalls.

Unfortunately, we continue to struggle with recalls and food safety illnesses associated with beef. Based on discussions with establishments and variation in pathogen testing results across establishments, it is apparent that establishments need additional data on the critical parameters of the available interventions. These data will allow them to improve their HACCP and food safety programs to ensure that the in-plant interventions are being applied in a manner to achieve optimal efficacy and to ensure that they are monitoring the parameters that are crucial for successfully controlling the pathogens of concern. Therefore, this project investigated variables that impact the efficacy of interventions and aimed to identify the critical parameters and procedures for effectively monitoring them.

Methodology

Paired, boneless, beef strip loin (n=120, IMPS 180) were selected at a commercial cow harvest facility, transported to the Center for Food Safety Food Microbiology Laboratory, Texas A&M University, and inoculated with nonpathogenic, rifampicin-resistant *E. coli* organisms (ATCC #1427, 1428, 1430) to simulate harvest floor contamination. The beef strip loins were inoculated hot (~30°C) and then subjected to one of three chemical treatments (L-lactic acid, peroxyacetic acid, and acidified sodium chlorite) including subset variations for concentration and pH. Lactic acid was applied warm (~53°C) and at room temperature (~25°C), whereas the peroxyacetic acid, and acidified sodium chlorite were applied at room temperature (~25°C). Lactic acid was applied at concentrations of 2.5% and 5% using different water sources (tap and distilled), and at a common pH of ~2.2 using different water sources (tap and distilled). Peroxyacetic acid was applied at concentrations of 210 ppm and 150 ppm, and acidified sodium chlorite was applied at concentrations of 500 ppm and 1200 ppm. Half of the strip loins received the chemical interventions prior to chilling or "hot" (~25°C), while the other half received the interventions after a chilling for ~24 h at ~2°C.

Findings

When applied to hot strip loins, only the 2.5% and 5% lactic acid treatments resulted in a greater than 1 log reduction, but for chilled strip loins all treatments achieved greater than a

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1 log reduction. When using tap water to prepare the intervention there was a difference between reductions for hot (0.68 CFU/cm^2) and chilled (2.02 CFU/cm^2) product, but there were no differences between hot and chilled for distilled water. Also, there were no differences in reductions between using tap and distilled water for hot products or for chilled products. The pHof the meat surface was lowest for the 5.0% lactic acid (3.07) and highest for the 150 ppm peroxyacetic acid (6.07).

Implications

Overall, data from this project clearly demonstrates that not all intervention parameters are critical to the efficacy of the intervention, and that not all intervention parameters can be assumed to be effective when applied to different surfaces (hot vs. chilled). Therefore, these data support the importance of conducting in-plant validation studies utilizing the specific intervention parameters being applied.

Table 1. Least squares means (SEM) for log CFU/cm^2 for reductions for hot vs. chilled strip loins x water.

	Reduction	
Water Source	**Hot**	**Chilled**
Tap	0.68^{c}	2.02^{a}
	(0.262)	(0.247)
Distilled	1.20^{bc}	1.56^{ab}
	0.257	(0.255)

$^{a-c}$ Means lacking a common letter differ ($p<0.05$)

Table 2. Least squares means (SEM) for log CFU/cm^2 for reductions for hot vs. chilled strip loins x acid treatment.

	Reduction	
Acid Treatment	**Hot**	**Chilled**
500 ASC	0.05^{ef}	1.04^{cde}
	(0.511)	(0.451)
1200 ASC	0.53^{def}	2.30^{bc}
	(0.466)	(0.450)
150 peroxyacetic	-0.39^{f}	1.34^{cde}
	(0.463)	(0.470)
210 Peroxyacetic	0.60^{def}	1.68^{bcd}
	(0.459)	(0.484)
2.5% Lactic[1]	1.42^{cd}	1.81^{bc}
	(0.319)	(0.330)
5.0% Lactic[1]	3.45^{a}	2.57^{ab}
	(0.321)	(0.339)

$^{a-f}$ Means lacking a common letter differ ($p<0.05$)

1 Represents both 25°C and 53°C lactic acid treatments.

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Table 3. Least squares means (SEM) for log CFU/cm^2 for reductions for hot vs. chilled strip loins x acid treatment x acid temperature.

Hot vs. Chilled Strip Loin 2.5% vs. 5% Lactic Acid	Acid Temperature	
	25°C	53°C
Chilled		
2.5%	1.59^{bc}	1.50^{bc}
	(0.499)	(0.509)
5.0%	2.31^{b}	2.29^{b}
	(0.506)	(0.516)
Hot		
2.5%	0.64^{c}	1.81^{bc}
	(0.521)	(0.50)
5.0%	4.33^{a}	2.22b
	(0.546)	(0.496)

$^{a-c}$ Means lacking a common letter differ ($p<0.05$)

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