Validation of Thermal Processing on Reducing Shiga toxin-producing *Escherichia coli* (STEC) and *Salmonella* on Whole Muscle Beef Jerky Strips

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INTRODUCTION

Jerky is a very popular ready-to-eat (RTE), dried meat product. In 2018, approximately 126.34 million Americans consumed a beef jerky product in the year. As a shelf-stable meat product proper thermal processing and protection from recontamination during handling are imperative, especially to control beef associated pathogens such *Salmonella* and shiga-toxin producing *Escherichia coli* (STECs) which have been implicated in outbreaks associated with whole muscle jerky products. Dry heat, commonly used for jerky manufacturing is less lethal than thermal processing under humid conditions, therefore, specialized thermal processing schedules need to be validated to minimize the risk.

OBJECTIVE

The objective of this study was to evaluate the performance of a modified smokehouse cook cycle in achieving a >6 $\log_{10}$ CFU/g reduction of *Salmonella* and *E. coli* (STEC) strains on whole muscle beef jerky strips.

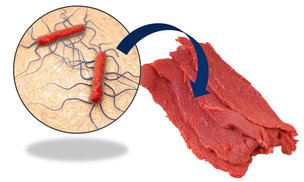
MATERIALS AND METHODS

- ✓ Raw beef strips (n=30 per replication) were processed in the Texas Tech Pathogen Laboratory per each tested organism.
  - Attachment (inoculated, no heat treatment; n=10)
  - After cooking (n=10)
  - Cooked non-inoculated strips (n=10) for water activity (Aw)
- ✓ Two replications of the study were conducted.
- ✓ Raw beef strips were submerged in each respective 7 strain cocktail see Table 1.

Table 1. *Salmonella* and STEC strains utilized for inoculation

Salmonella strains	STEC strains
S. Enteritis BAA 708	*E.coli* O157:H7
S. Enteritis 13076	*E.coli* O26
S. Heidelberg	*E.coli* O111
S. Seftenberg 43845*	*E.coli* O145
S. Typhimurium 13311	*E.coli* O45
S. Typhimurium 14028	*E.coli* O103
S. Newport 6962	*E.coli* O121

** Thermotolerant Salmonella strain, used for thermal processing validation*



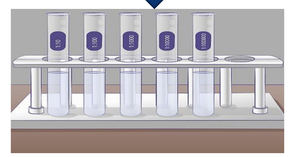
Inoculation by submersion for 5 min.

10 g diluted in 90 ml of BPW

Homogenized 230 rpm for 2 min.

Cooking

Vacuum packaged



Serial dilutions

- After dilutions were prepared samples were plated in duplicate onto xylose-lysine-deoxycholate (XLD) for *Salmonella* and MacConkey agar for STEC each were overlaid with a thin layer of tryptic soy agar (TSA) and incubated at 37 °C for 18-24 hrs.
- Aw was measured by dicing approximately 5 g of cooked sample and reading with a Hygrolab C1 (Rotronic; Hauppauge, NY).
- Counts were subject to log transformation for reporting.
- Analyzed via Dupont® BAX® PCR analysis
- Enrichment in TSB for 12-18 hr at 37 °C

RESULTS

Table 2. *Salmonella and STEC average reduction after smokehouse cooking. Ten strips per replication (2 replications) per organism*

Organism	Rep	Mean Reduction (± std deviation)	Reduction Achieved (Log CFU)/g)	BAX positive (%)	Culture Confirmed (%)
Salmonella spp.	1	6.8 (± 0.2)	6.6	100	0
				100	0
				100	0
	2	6.4(± 0.1)		100	0
				100	0
				100	0
STEC	1	6.8 (± 0.1)	6.5	100	0
				100	0
				100	0
	2	6.1(± 0.2)		100	0
				100	0
				100	0

Table 3. *Average water activity of beef jerky strips. Averaged together to assess the reduction achieved in the smokehouse for each organism*

Product Type	Rep	Average Aw	Mean Aw	Average pH	Mean pH
Beef	1	.897	0.90	5.87	5.62
	2	.908		5.37	

CONCLUSION

- ✓ The thermal processing schedule described in this project is effective at achieving more than a 6 $\log_{10}$ CFU/g reduction.
- ✓ This study provides scientific support to process reduced-moisture jerky-type products in a commercial setting.
- ✓ Jerky processors need to validate their processing schedules to assure pathogen control in their products.

REFERENCES

- FSIS. 2014. Compliance Guidelines for Meat and Poultry Jerky Produced by Small and Very Small Plants.
- FSIS. 2017. *Salmonella* Compliance Guidelines for small and very small meat and poultry establishments that produce Ready-to-Eat (RTE) products and revised appendix A.

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