

**Validation of a Lactic Acid-based  
Antimicrobial Product for the  
Reduction of *E. coli* O157:H7 and  
*Salmonella* on Beef Tips and Whole  
Chicken Carcasses**

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## INTRODUCTION

- Continual challenge to control *Salmonella* and *Escherichia coli* O157:H7 in beef and poultry industry
  - ~ 12-35% chicken carcasses exit with *Salmonella*
  - ~ 2% beef tips with *Salmonella*
  - ~ 40% beef carcasses with *E. coli* O157:H7



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## BEEFXIDE® and CHICXIDE®

- Buffered blends of natural L (+) lactic acid and citric acid
- A blend of lactic acid (45-60%), citric acid (20-35%), and potassium hydroxide (>1%)
- Chicxide® is intended for use as an antimicrobial treatment for poultry in compliance with FSIS Directive 7120.1 that allows organic acids at 2.5% to be used as a processing aid.



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## BEEFXIDE<sup>®</sup> and CHICXIDE<sup>®</sup>

- Beefxide<sup>®</sup> is approved as a spray-on beef carcasses, beef heads and beef organs (except livers)
- Use on primal cuts, sub-primals, cuts and trim is pending USDA Approval



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## Mechanism Lactic and Citric Acid

- Citric acid has the highest inhibitory effect due to its ability to diffuse through the cell membrane.
- Lactic acid decreases the ionic concentration within the bacterial cell membrane of the exterior cell wall of the bacterial organism.



## Mechanism Lactic and Citric Acid, *continued*

1. Accumulation of the acid within the cell cytoplasm
2. Acidification of the cytoplasm
3. Disruption of the proton-motive force and inhibition of substrate transport



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## OBJECTIVES

- Determine the effects of Chicxide<sup>®</sup> in reducing *Salmonella* on broiler carcasses
- Determine the effects of Beefxide<sup>®</sup> in reducing *Escherichia coli* O157:H7 and *Salmonella* on beef tips



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## METHODS: WHOLE CHICKEN CARCASSES

- 40 broilers were raised for 40 days at the Texas Tech University (TTU) Farms
- Transported to the TTU Poultry Processing facility and were conventionally processed
- Transported to the Pathogen Processing facility at TTU



## METHODS: WHOLE CHICKEN CARCASSES

- Twenty-five carcasses were inoculated individually in a poultry rinse bag with the *Salmonella* inoculums and shaken by hand for five minutes to yield a surface inoculums level of  $10^6$  CFU/ml
- Carcasses were allowed to stand for 30 minutes at 4°C to facilitate bacterial attachment & then assigned to treatment groups



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## METHODS: WHOLE CHICKEN CARCASSES

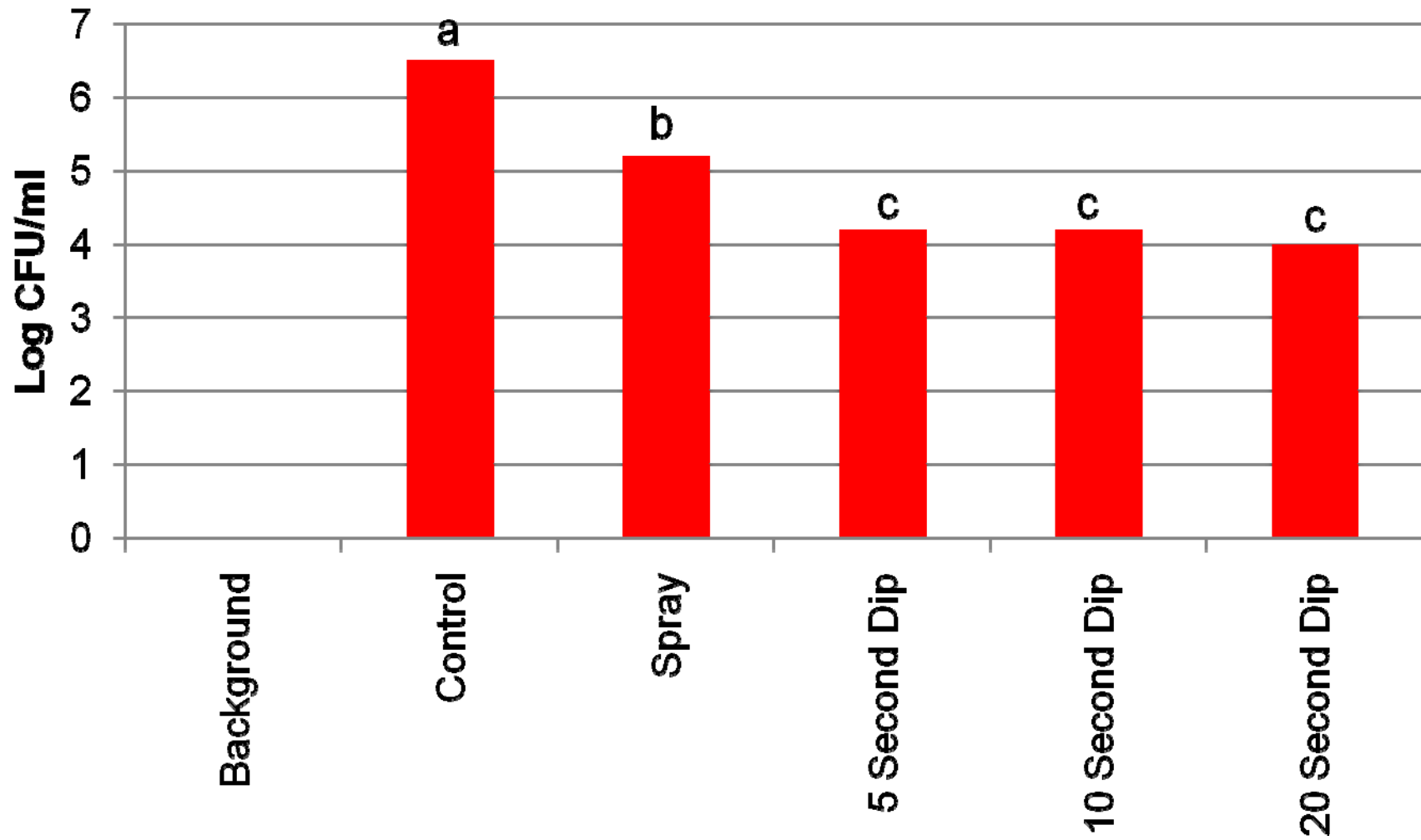
1. Control (no treatment)
2. 5 second spray of 2.5% Chicxide<sup>®</sup> at 40 lb/in<sup>2</sup> at ambient temperature
3. 5 second dip in 2.5% Chicxide<sup>®</sup> at ambient temp.
4. 10 second dip in 2.5% Chicxide<sup>®</sup> at ambient temp.
5. 20 second dip in 2.5% Chicxide<sup>®</sup> at ambient temp.



## METHODS: WHOLE CHICKEN CARCASSES

- The samples were rinsed using the USDA Whole Bird Rinse Guidelines
- Dilutions were plated onto Xylose Lysine Tergitol 4 (XLT4) plates with a thin Tryptic Soy Agar (TSA) overlay for recovery of injured *Salmonella* cells
- XTL4 plates were incubated at 37°C and counted after 48 hours

## Salmonella Counts of Whole Chicken Carcasses treated with 2.5% Chicxide<sup>®</sup>





## RESULTS: WHOLE CHICKEN CARCASSES

- Initial concentration of 6.5 log CFU/ml of *Salmonella* (Control)
- Spraying the carcasses for five seconds with Chicxide<sup>®</sup> resulted in a reduction of 1.3 log CFU/ml
- Dipping the carcasses for 5, 10 or 20 seconds yielded a 2.3 log CFU/ml reduction ( $P < 0.05$ )
- There were no significant differences between dipping carcasses for 5, 10 or 20 seconds ( $P > 0.05$ )



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## CONCLUSION: WHOLE CHICKEN CARCASSES

- Spray or dip applications of 2.5% Chicxide<sup>®</sup> would be beneficial in improving food safety
- Spray application is easier to implement in the current processing environment
- A 5 second dip in 2.5% Chicxide<sup>®</sup> maximizes the time to cost benefits and reduces *Salmonella* incidence by 2 log cfu/ml



## METHODS: BEEF TIPS

- 30 USDA Select, beef tips were obtained from a commercial processing facility and transported to the pathogen processing facility at TTU
- 10 tips were assigned to three treatment groups – non-inoculated, inoculated with *E. coli* O157:H7, inoculated with *Salmonella*



## METHODS: BEEF TIPS

- Inoculum was applied by dipping the sub-primals in a pathogen inoculated buffer solution at a  $10^4$  cfu/ml
- The *E. coli* inoculum contained 4 strains of O157:H7 and the *Salmonella* inoculum contained 4 strains



## METHODS: BEEF TIPS

- Treatments were distributed as follows:
  1. Non-inoculated control
  2. Non-inoculated with treatment spray
  3. *Escherichia coli* O157:H7 control
  4. *Escherichia coli* O157:H7 treated
  5. *Salmonella* control
  6. *Salmonella* treated



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## METHODS: BEEF TIPS

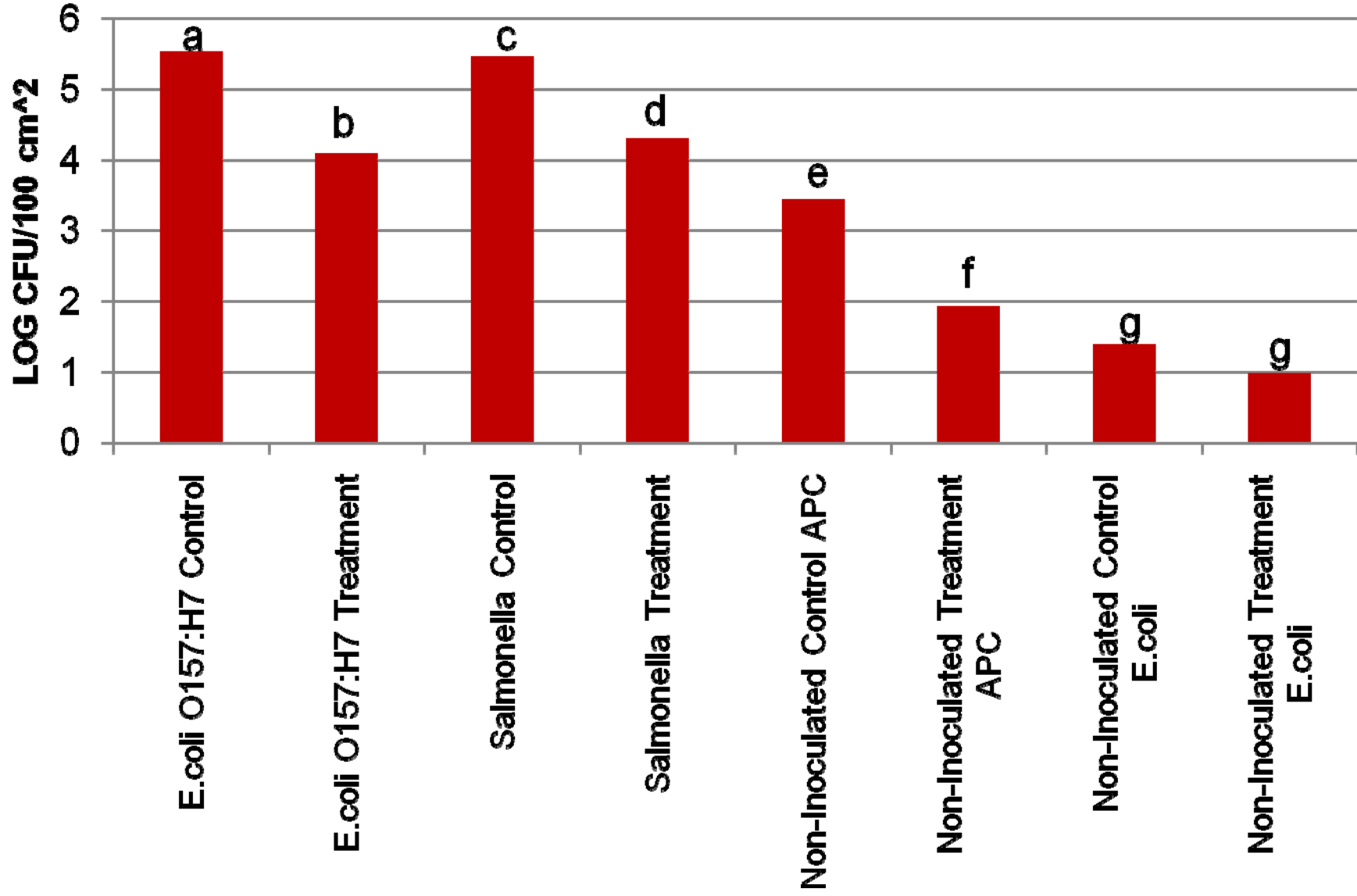
- Tips were allowed to sit for one hour at refrigerator temperature to facilitate attachment
- 5 tips from each treatment group were sprayed with a 2.5% solution of Beefxide<sup>®</sup> using a trim sanitizing spray cabinet
- Beef tips moved along the chain at a rate of 1 foot every 2 ½ seconds.



## METHODS: BEEF TIPS

- External surface of each beef tip was swabbed (100 cm<sup>2</sup> area) to determine pathogen loads on the fat and lean surface of the product
- Appropriate dilutions and plating followed
- The non-inoculated control and treatment were plated onto MAC and APC agar
- The non-inoculated control and treatment were plated onto MAC and APC agar
- Samples containing *E. coli* O157:H7 were plated onto  
MAC with a thin-layer of TSA
- Samples containing *Salmonella* were serially diluted and plated onto XLD agar with a thin-layer of TSA

# Beefxide<sup>®</sup> on Beef Tips





## RESULTS: BEEF TIPS

- The *Escherichia coli* O157:H7 was reduced by 1.4 LOG CFU/100 cm<sup>2</sup> ( $P < 0.05$ )
- The *Salmonella* species by 1.1 LOG CFU/100 cm<sup>2</sup> ( $P < 0.05$ )
- The generic *Escherichia coli* decreased by 0.4 LOG CFU/100 cm<sup>2</sup> ( $P > 0.05$ )



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## CONCLUSION: BEEF TIPS

- The results show that treatment with Beefxide<sup>®</sup> was effective in reducing inoculated populations of both *E. coli* O157:H7 and *Salmonella* on beef tips
- Beefxide<sup>®</sup> was also effective at reducing the background flora (APC and generic *E. coli*)



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## FINAL THOUGHTS

- Beefxide<sup>®</sup> may be a viable option in providing the industry with another product to further reduce pathogen loads
- Additionally, with concerns of increased cases of *salmonellosis* in the United States, Chicxide<sup>®</sup> may be a viable option for the industry to decontaminate poultry products



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## ACKNOWLEDGEMENTS

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- AMI
  - Birko Corporation
  - Texas Tech University
  - Meat and Poultry Industry
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**ANY QUESTIONS?**

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