Title: Use of Alternative Salts in Biltong Marinade to Reduce Sodium and Still Achieve USDA-FSIS >5-log Reduction of Salmonella

Caitlin Karolenko1,2 and Peter Muriana1,2. 1Robert M. Kerr Food and Agricultural Products Center and the 2Department of Animal and Food Sciences, Oklahoma State University, Stillwater, OK.

Introduction: Biltong is a South African style dried beef product that is manufactured using lean beef marinated with salt, spice, and vinegar followed by a drying 5-10 day period at moderate heat and humidity. Despite the lack of a heat lethality step, the manufacturing process still must achieve a USDA-FSIS recommended 5-log reduction of Salmonella for safe production in the United States. Previous work in our lab achieved a 5-log reduction of Salmonella while simply using sodium chloride and vinegar in the marinade. The USDA-FSIS does not accept replacement of sodium chloride with alternative salts unless the recommended 5-log reduction of Salmonella can be proven.

Purpose: This study aimed to evaluate the use of the alternative salts, potassium chloride (KCl) and calcium chloride (CaCl2) in biltong marinade to achieve the USDA-FSIS recommended 5-log reduction of Salmonella.

Methods: Beef pieces (1.9-cm x 5.1-cm x 7.6-cm) were inoculated with a five-serovar mixture of Salmonella (Salmonella Thompson 120, Salmonella Heidelberg F5038BG1, Salmonella Hadar MF60404, Salmonella Enteritidis H3527, and Salmonella Typhimurium H3380), vacuum-tumbled in a traditional biltong marinade comprised of spices (coriander, black pepper), 100-grain vinegar (4% formulation), and 2.2% salt (NaCl, KCl, or CaCl2) and dried in a humidity-controlled oven for 8-10 days at 23.9°C (75°F) and 55% relative humidity. Microbial enumeration of Salmonella was conducted post-inoculation, post-marination, and after 2, 4, 6, 8, and 10 days of drying. Sodium, calcium, and potassium ion concentrations were measured using ion-specific meters. Trials were performed in duplicate replication with triplicate samples tested at each time period. Treatments were compared for significant differences (p < 0.05) by Repeated Measures One Way ANOVA.

Results: Biltong produced with CaCl2, NaCl, or KCl achieved a > 5-log reduction of Salmonella after 6, 7, and 8 days respectively, with water activity < 0.85. Biltong processes made with NaCl or CaCl2 were not significantly different (p < 0.05) but both were significantly different from biltong made with KCl (p > 0.05). Regardless of the salt used in the marinade, potassium ion levels were moderately elevated in all samples and was attributed to potassium found in beef.

Significance: KCl or CaCl2 used in place of NaCl in biltong marinade was able to achieve > 5-log reduction of Salmonella to satisfy USDA-FSIS validation. The data provided herein with alternative salts will enable manufacturers to produce safe, healthy, and low-sodium RTE dried beef products for consumers.

Keywords: Biltong, dried beef, Salmonella, salt, process validation.