Introduction:

Beef jerky is often processed at low temperature and/or low humidity to attain desired quality. The low-humidity heating reduces process lethality due to enhanced heat-resistance in pathogens such as Salmonella. Additionally, evaporative cooling occurs on the surface of the strips, reducing the temperature to which pathogens are exposed. The USDA/FSIS has identified Salmonella, E. coli O157:H7, L. monocytogenes, and S. aureus as pathogens of concern in beef jerky (5). Because Salmonella is considered the most heat resistant, destruction of Salmonella is believed to ensure the safety of the other pathogens (5). In response to several illness outbreaks linked back to beef jerky over the last 40 years, the USDA/FSIS requires processors to validate a 5-log reduction in Salmonella during the manufacture of jerky in order to ensure the safety of the finished product (5). Validation can be costly and time consuming for small processors. Most available research validates single-step processes or additional chemical treatments (2, 3, 4), thereby limiting process options and making it difficult for processors to continue using their unique processes (2, 3, 4).

Lactic acid bacteria (LAB), particularly Pedococcus spp., have been shown to be effective pathogen surrogates in the validation of ground-and-formed beef jerky processes (1). Using LAB as surrogates is a safe way to perform challenge studies specific to unique processes.

Objective:

Our objective was to develop a novel in-plant validation method which uses a GRAS LAB starter culture as a surrogate for pathogens in whole muscle beef jerky processing.

Materials and Methods:

Jerky Strip Preparation:

• Beef rounds, knuckles, and shoulder roasts sliced and cut into identical strips (5.08 cm × 15.24 cm by 0.60 cm).
• Average strip weight was 22.9 g (n=275).

Inoculum Preparation:

• Inocula consisted of approximately 10^8 CFU/ml of either Listeria monocytogenes (5 strains), Staphylococcus aureus (5 strains), Salmonella enterica serovar typhimurium (5 strains), or a combined inoculum of E. coli O157:H7 and Salmonella spp. (5 and 8 strains, respectively).
• Pathogen inocula were prepared from stationary-phase cells that were re-suspended in Butterfield’s phosphate diluent (BPD).
• LAB inoculum was prepared from 0.5 g of Saga 200 re-suspended in 9 ml BPD.

Inoculation of Jerky Strips:

• Strips were laid out in groups of four, consisting of one strip inoculated with E. coli O157:H7 and Salmonella spp., and one strip each inoculated with L. monocytogenes, S. aureus, or LAB (Figure 4).

Enumeration of Surviving Cells:

• At designated intervals, four jerky strips per spice (one per inoculum) were removed from the samples taken post-marination/smokehouse, and placed separately in Whirl-Pak® bags with 9 ml of BPD and stomached for 2 min at medium speed. Further serial dilutions were made in BPD.
• E. coli O157:H7 and Salmonella were enumerated using modified eosin methylene blue (M-EMB) agar prepared from lactose-free EMB (Difco) with the addition of 10 g D-galactositol and 5 g NaCl. This medium has been shown to be superior for enumerating these pathogens in jerky (7). For enumeration of L. monocytogenes, S. aureus, and Saga 200, samples were spread on brain-heart infusion agar (BHA, Difco, Figure 5), followed by 1 h at 35°C (repair/injury) and selective medium overlays: Listeria Selective agar (LSA, Difco) with Listeria selective supplement (Difco), Bord-Parker (BP) agar with egg yolk-tellurite supplement (Difco), and lactobacilli deMan, Rogosa Sharp (MRS) agar (Difco), respectively (Figure 6). Samples were incubated at 35°C for 48 h (MEMB, 48 h LSA, BP, and MRS overlay plates). The count (log CFU/cm²) for each organism was calculated, and mean counts were calculated for each organism-spice combination at each sampling time.

Conclusions:

Saga 200 is a suitable pathogen surrogate that can be used to create an in-plant validation tool. This validation tool will be cost-effective and easy for the processor to use. It will also provide the processor with a scientifically supported method to meet FSIS regulations while maintaining their original process and product. The validation tool will help processors produce safe jerky and identify processes that could result in unsafe jerky.

References:


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