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Meat and Muscle Biology™

Thermal Inactivation of Salmonella and Listeria Monocytogenes in Beef Patties, Chicken Patties, Chicken Tenders, and High-Fat Frankfurters

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Objectives

To determine the temperature-death times of *Salmonella* and *L. monocytogenes* in beef patties, chicken patties, chicken tenders, and frankfurter batter at four different temperatures and validate these findings using commercial products and cooking processes.

Materials and Methods

D-value determination. Two hundred grams of finely ground meat were inoculated to 8-log cfu/g of either *Salmonella* or *L. monocytogenes* (5-strain mixtures). One-g samples of inoculated meat were flattened into a thin film in moisture-impermeable pouches and vacuum-packaged. Samples were heated at one of four temperatures (54.4, 60.0, 65.6, and 71.1°C) in a water bath. Triplicate samples were removed periodically during cooking, chilled to ≤ 4°C, and enumerated for the survival of *Salmonella* or *L. monocytogenes*. D-values were calculated from the linear regression on log reduction of pathogen versus time. This experiment was replicated three times.

Batch oven validation. Inoculated frankfurter links were thermally processed in a combination steam/convection oven following one of 2 cook schedules until an internal temperature of 71.1°C was achieved. The control cycle met USDA, FSIS Appendix A relative humidity requirements while the test cycle only applied steam during the final step of the process. For both cycles, triplicate links were removed when product internal temperature reached 54.4°C, 62.7°C, and 71.1°C. This experiment was replicated twice.

Impingement oven validation. Inoculated beef patties, chicken patties and, chicken tenders were cooked via passage through two in-line impingement ovens. Samples were cooked to one of two temperatures (71.1°C and 79.4°C for poultry, 71.1°C and 76.7°C for beef) following either a control cycle or a test cycle. The control cycle applied no steam while the test cycle used a target wet-bulb temperature of 71.1°C (for target 1.2% rH) in the second oven. For each trial, triplicate samples were removed prior to cooking and on exit from each oven for enumeration of surviving pathogens. This experiment was replicated twice.

Results

D-values for *Salmonella* were shorter than those for *L. monocytogenes* across all products and temperatures tested. For batch oven cooking, both cook cycles resulted in ≥ 5.0 log reduction of *Salmonella* and *L. monocytogenes* in frankfurters. With a target temperature of 71.1°C, the control and tests cycles produced a 4.21 ± 2.22 and 5.53 ± 0.06 log reduction of *L. monocytogenes* in chicken tenders, respectively, during impingement cooking. Neither cycle was able to produce ≥ 5.0 log reduction of *Salmonella* in chicken tenders cooked to 71.1°C.

Conclusion

For non-impingement processes USDA, FSIS Appendix A time-temperature recommendations are adequate for controlling 1) *Salmonella* when the final cooking temperature meets or exceeds 60.0°C and 2) *L. monocytogenes* when the final cooking temperature meets or exceeds 71.1°C. *Salmonella* is more thermotolerant than *L. monocytogenes* during impingement processing. D-values suggested that 71.1°C should produce an instantaneous ≥ 5.0 log reduction of *Salmonella* however this was not observed in rapid processes (≤4.0 min) Incorporation of high wet-bulb temperature targets into impingement processes may be necessary to ensure adequate control of *Salmonella*.