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Efficiency of Phage Intervention on *Salmonella* Kill on Lean Pork, Pork Trim and Bacon

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Objectives

Raw Pork Products Exploratory Sampling Program (2015) by FSIS, USDA aims to estimate the prevalence and levels of *Salmonella* in various fresh pork cuts and products. The results of this ongoing baseline sampling program will provide direction to FSIS and the Agency to develop a better risk profile and refine the present food safety guidelines for pork products. New impending regulatory standards will likely prompt establishments to seek interventions that can help in reducing the prevalence and most probable number of *Salmonella* in their products.

Bacteriophages are ubiquitous antibacterial agents that can invade and kill specific target pathogenic bacteria in foods. PhageGuard S, is a commercial salmonella based phage cocktail consisting of 2 phages, FO1a and S16. Having been found in nature, these phages are a natural and organic way to kill salmonella and reduce risk in various types of food products. Phage have a number of other added benefits over traditional chemical processing aids as well. There is no impact to the sensorial properties of foods and no impact on worker safety, wastewater or processing equipment. As such, the use of *Salmonella*-phages as a biocontrol agent for *Salmonella* can be an interesting avenue to explore for the meat industry.

This study determines the efficacy of a commercially available phage product, PhageGuard S, for *Salmonella* kill on several types of pork including—lean meat, bacon and pork trim.

Materials and Methods

Overnight culture of *Salmonella* Se13 streptomycin resistant strain was diluted and inoculated at a concentration of 2×10^4 CFU/cm² or CFU/g on lean pork, bacon or pork trims (duplicate samples per treatment).

Subsequently, contaminated samples were treated with either of the following phage concentrations (5×10^6 , 1×10^7 , 2×10^7 or 5×10^7 PFU/cm² or PFU/g) or water (control). After treatment, samples were stored at 40°F (4°C) for 18 h before retrieval and enumeration of bacteria on selective agar plates.

Results

The application of phages 10^7 and 5×10^7 PFU (Plaque Forming Unit)/cm² on lean pork resulted in 1.1 log₁₀ CFU/cm² and 1.6 log₁₀ CFU/cm² reduction of *Salmonella* respectively (mean value of 2 individual experiments). On Bacon, the highest phage concentration showed *Salmonella* reduction of 1.3 log₁₀ CFU/cm² and the lowest phage concentration resulted in 0.8 log₁₀ CFU/cm² reduction (mean value of 2 individual experiments). When applied on pork trim, phage concentration 2×10^7 and 5×10^7 PFU/g showed *Salmonella* kill of 1.3 log₁₀ CFU/g and 1.7 log₁₀ CFU/g, respectively. Overall, a dose response was observed where increasing phage concentration resulted in an increasing *Salmonella* kill on different pork meat.

Conclusion

Phage technology is an easy, safe intervention and an alternative to chemicals and antibiotics in controlling of *Salmonella* in slaughter and processing environments. The above results indicate that the commercially available phage solution, PhageGuard S, can reduce *Salmonella* contamination on pork by 1.3 to 1.7 log₁₀. Therefore, making it an effective *Salmonella* intervention for processors to reduce risks and allow for increase in consumer safety.