MEAT SCIENCE AND MUSCLE BIOLOGY SYMPOSIUM: Development of bacteriophage treatments to reduce *Escherichia coli* O157:H7 contamination of beef products and produce

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Abstract

*Escherichia coli* O157:H7 remains a foodborne pathogen of concern with infections associated with products ranging from ground beef to produce to processed foods. We previously demonstrated that phage-based technologies could reduce foodborne pathogen colonization in live animals. Here, we examined if a 3-phage cocktail could reduce *E. coli* O157:H7 in experimentally contaminated ground beef, spinach, and cheese. The 3 phages were chosen from our *E. coli* O157:H7 phage library based on their distinct origins of isolation, lytic ranges, and rapid growth (40- to 50-min life cycle). Two phages belonged to the Myoviridae family and the other phage belonged to the Siphoviridae family. The phage cocktail was added to ground beef, spinach leaves, and cheese slices contaminated with *E. coli* O157:H7 (10^7 cfu) at a multiplicity of infection of 1. Phage treatment reduced (*P* < 0.05) the concentrations of *E. coli* O157:H7 by 1.97 log_{10} cfu/mL in ground beef when stored at room temperature (24°C) for 24 h, 0.48 log_{10} cfu/mL at refrigeration (4°C), and 0.56 log_{10} cfu/mL in undercooked condition (internal temperature of 46°C). Likewise, phage treatment reduced (*P* < 0.05) *E. coli* O157:H7 by 3.28, 2.88, and 2.77 log_{10} cfu/mL in spinach when stored at room temperature for 24, 48, and 72 h, respectively. Phage treatment, however, did not reduce *E. coli* O157:H7 concentrations in contaminated cheese. Additionally, 3 phage-resistant *E. coli* O157:H7 strains (309-PR [phage resistant] 1, 309-PR4, and 502-PR5) were isolated and characterized to test if phage resistance could limit long-term use of phages as biocontrol agents. Growth kinetics and adsorption assays indicated that phage resistance in strains 309-PR4 and 502-PR5 was mediated, at least in part, by prevention of phage adsorption. Phage resistance in strain 309-PR1 was the result of limited phage proliferation. Phage resistance was stably maintained in vitro throughout a 4-d subculture period in the absence of phage. No significant reductions in bacterial growth or cell adhesion were observed in resistant strains. Taken together, our results provide additional support for the use of phage to control *E. coli* O157:H7 in food products; however, the emergence of phage-resistant bacteria could limit the efficacy of phage products. Therefore, further studies are needed to develop resistance mitigation strategies to optimize phage-based technologies.