

Phages show promising potential to improve safety of poultry products

Bacteria “eaters” are antimicrobial option to reduce the risk of key foodborne pathogens

Campylobacter and *Salmonella* continue to top the list of troublesome foodborne pathogens in Canada. They live in the intestines of many food producing animals, including poultry, and commonly contaminate raw meat products during slaughtering and processing. An Ontario researcher is looking at bacteriophage – bacteria “eaters” – viruses that specifically attack target bacteria to improve food safety that could reduce the use of conventional antimicrobials.



Dr. Hany Anany, research scientist, Guelph Research and Development Centre, Agriculture and Agri-Food Canada

There are many points along the path from farm to table where contamination can occur. “Research clearly indicates that cross contamination during processing and chilling steps is taking place and represents a significant food safety risk during poultry processing,” says Dr. Hany Anany, research scientist with Agriculture and Agri-Food Canada, and lead investigator on a three-year research project looking at the use of bacteriophage to reduce the risk of foodborne pathogen contamination on poultry products during processing.

New interventions needed

Studies over the last decade at provincial and federally inspected poultry processing plants confirm the ongoing issue of pathogen contamination, and highlight the need for new strategies and tools to reduce the risk and improve overall food safety. An Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) study looked at the prevalence of *Campylobacter* and *Salmonella* in broilers at processing plants and found the pathogens were more prevalent after chilling (including rinsing), compared to when live birds arrived at the plant.

A study at federally inspected plants in Canada had similar findings, examining the prevalence of the pathogens in whole carcasses and cut-up chicken parts. The National Microbiological Baseline Study (2012-2013) reported that *Salmonella* showed up on 16.9% of whole carcasses and 29.6% of cut-up parts, *Campylobacter* was on 27.4% of whole carcasses and 39% of cut-up parts.

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Anany has been studying the use of phages as a way to mitigate the risk of different foodborne pathogens to improve food safety for the past 16 years. “There is clear evidence that *Campylobacter* and *Salmonella* are ongoing and unresolved challenges for the poultry industry and Canadian consumers,” he says. “We need to explore various innovative and cost-effective interventions that can be applied during processing to reduce the pathogen burden without affecting the quality of the final poultry product.” He is partway through a research project to use phages – a green, environmentally- friendly technology – as a novel antimicrobial option during poultry processing. His research – with funding through the Canadian Poultry Research Council’s poultry science cluster – is exploring the use of bacteriophages during poultry carcass chilling and packaging as a novel new way to control *Campylobacter* and *Salmonella* contamination.

The promise of phages

Lytic phages are bacterial viruses designed to only infect a specific host – e.g. *Campylobacter* or *Salmonella* – to disrupt the pathogen's regular metabolism and effectively kill it. Several studies have shown the efficiency of phages to control the growth of different bacterial pathogens.

"Phages are a promising antimicrobial intervention that could be used before, during and after the water-based chilling step of poultry product processing," says Anany. "Although phages aren't yet being used in the poultry industry, post-chill use shows promise."

In Canada and the U.S., some phage products have been approved and are used during food processing and on ready-to-eat food products. Phages can be implemented at various stages of the food chain," says Anany. "I see phages as one of the available tools we can use to mitigate the bacterial pathogen risk. We need to include phages as part of the hurdle technology to improve food safety through alternative antimicrobial options. And we have to understand the biology of phages and host interaction to implement them at the right stage of the processing chain using appropriate application approaches (encapsulation, spraying, immersion) to ensure their efficacy."

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Anany's research is looking at two application approaches of phages – free and immobilized – at two critical points during poultry processing, as a means to improve food safety without impacting the quality of the poultry products.

"Free" phages can be applied to whole carcasses and cut-up parts by dipping or spraying a phage suspension before packaging to significantly reduce contamination of target pathogens – *Campylobacter* and *Salmonella* in this case – in the final consumer product.

"Immobilized" phages could be used in the absorbent pads within poultry product packaging to further minimize contamination during the product's shelf life. "Phage-based bioactive packaging would be a controlled release to ensure added phages would be able to tackle any existing and post-processing contamination during the shelf life of the product. This would extend product shelf life and improve food safety while maintaining the quality of the packaged food, including poultry products," says Anany.

Commercial potential

While phages are not currently used in poultry production in Canada, Anany believes this is because cost may be the biggest barrier for poultry processors. "It would be ideal if there was an integrated production system that includes phages throughout the production chain from farm to retail. Phages could be added to feed and water for poultry on the farm, sprayed before and during processing and in absorbent pads for in-store packaging." Anany also points to the need for more, large scale experiments to support results found at the laboratory level.

Anany's research began by screening poultry samples from commercial processing facilities to isolate *Campylobacter* and *Salmonella* specific bacteriophages. "We already have some promising phage candidates to be used in biocontrol experiments," he says. "Our hope is to ultimately deliver a cost-effective and environmentally-friendly strategy for commercial processing poultry facilities to help mitigate two of the top foodborne pathogens – improving safety of whole carcasses and cut-up parts without compromising food quality."

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