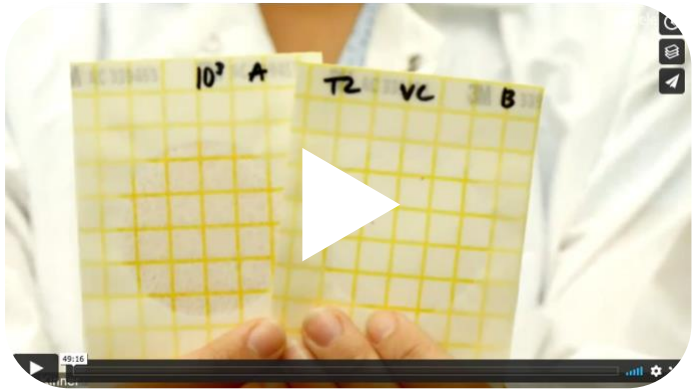
# GCPS Science and Engineering Fair Activity

## How do we know our food is safe?

**Food manufacturing companies, like Tyson and Nabisco, employ scientists to make sure the food they produce is safe before it makes it to the store.**

**But what do these scientists do to make sure the food is safe? And how else do scientists and engineers play a role in food production and food safety?**

**Watch this video featuring Stephanie Richter, Research Scientist in the Agricultural Technology Research Program at the Georgia Tech Research Institute to learn more about science and innovation in food production. After watching, read on to learn more about how researchers from GTRI have helped to improve the poultry chilling process.**




Georgia Tech Research Institute
STEM@GTRI

ENGINEERING TOMORROW'S POULTRY INDUSTRY

# PoultryTech

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## Researchers Further Validate Ice Slurry's Antimicrobial Capability for Poultry Chilling

Poultry processors in North America typically use water immersion chilling systems to lower the temperature of carcasses to a degree that inhibits pathogen growth. They also add an antimicrobial agent to the water as an extra safeguard. These necessary precautions use considerable amounts of water, energy, and antimicrobials.

Researchers at the Georgia Tech Research Institute (GTRI) are investigating the feasibility of using ice slurry (a mixture of tiny ice crystals and liquid water) as an alternative chilling medium both for its increased cooling capacity and antimicrobial properties. They hypothesize that the ice slurry's grain acts as a scrub on the external surface of the carcass, dislodging or eroding skin-attached pathogens and releasing them directly into the chiller's water. This direct abrasion could possibly reduce bacterial loads and lower the amount of antimicrobials needed.

Initially, the team conducted tests using a 250-gallon scaled auger chiller and *Salmonella*-spiked whole bird carcasses. The chiller included the antimicrobial, peracetic acid (PAA), with either chilled water or ice slurry. Results showed up to twice the reduction in CFU/mL of pathogen presence when ice slurry was used as the chilling medium instead of chilled water. In addition, the ice slurry's greater cooling capacity enabled the carcasses' core temperatures to drop faster than when using just the chilled water.

Recently, the team switched testing protocols to use chicken parts, specifically wings, inoculated with *Salmonella* and again chilled by either water or ice slurry. To expedite testing, they also designed and built 30-gallon micro-chillers.

"The micro-chiller allows us to conduct more tests per day compared to the larger chiller, which means we can get more replicates and better statistical analysis," explains Dr. Daniel Sabo, a GTRI research scientist and the project's lead chemist.

"Before, with the larger chiller, it would take two days a week to get one comparative replicate. With the micro-chillers, we can now get up to two comparative replicates in a single day because the two micro-chillers can run concurrently," adds Stephanie Richter, who is leading the biological testing protocols for the project, and recently earned a Master of Science in Biology from the Georgia Tech School of Biological Sciences.

For the micro-chiller tests, each chiller medium contained the same initial volume of PAA based on a total volume of 60 L (liquid and ice fraction) and similar salinity readings. A baseline was established

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*Stephanie Richter, graduate research assistant, uses a GTRI-designed micro-chiller to test ice slurry's antimicrobial capability for chicken parts (wings) chilling.*

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(wings that were inoculated but not chilled) to provide representative *Salmonella* concentrations before chilling interventions.

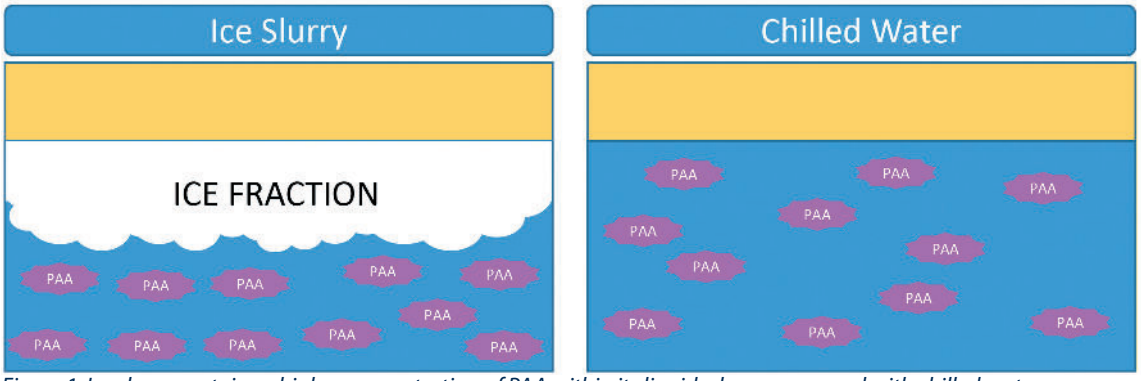


*Figure 1. Ice slurry contains a higher concentration of PAA within its liquid-phase compared with chilled water.*

Using four different combinations of experimental factors (PAA concentration, salt concentration, and immersion time), researchers found that, on average, the ice slurry once again provided a greater reduction in pathogens than chilled water.

"Our experimental results continue to support the hypothesis that ice slurry has a thermomechanical advantage over chilled water with regard to antimicrobial efficacy," notes Dr. Comas Haynes, GTRI principal research engineer and project director.

Also noteworthy, when adding the same volume of PAA to ice slurry and chilled water, the ice slurry contains a higher concentration of PAA within its liquid-phase compared with chilled water (see Figure 1).

Researchers liken this effect to adding sugar to unsweetened tea. Picture two glasses, one empty and one filled with ice. Now picture one sugar packet being added to both glasses and then each filled with the unsweetened tea. You will find that the glass containing ice will be sweeter. In other words, the sugar is in a smaller volume of liquid and more concentrated.

The same holds true for the ice slurry as a chilling medium. In this case, the PAA is the "sugar" and it is only in the liquid portion of the slurry. This means the PAA is more concentrated in the liquid water portion. The same applies to the salt concentration in the slurry.

The team considered this before conducting additional tests to control for these confounding variables and to hone in on the mechanical abrasive quality of the slurry.

"We proportionally reduced the volume of PAA added in the slurry based on the initial ice fraction so that both the slurry and the water chilling tests would effectively have the same initial [liquid-phase] concentration in either case," says Haynes.

Therefore, adjusting for the PAA and salinity, results again generally showed an increase in pathogen reduction with the slurry compared with the chilled water, further adding validity to their hypothesis that there is a scrubbing phenomenon at play.

As such, researchers believe that ice slurry can potentially provide poultry processors with an alternative chilling medium that gives them the same antimicrobial effect without having to invest as much in PAA or other antimicrobial costs.

"By using slurry, we are indirectly increasing PAA's kill potential. Because if you are adding the same volume of PAA in chilled water, it has a lower comparative concentration in parts per million, whereas in slurry water, it has a higher concentration. So there is still a cost savings. Processors can either reduce the amount of PAA or they can add the same amount of PAA and still get a higher kill of microbials than in just chilled water," says Sabo.

The team is currently investigating whether the salt concentration within the ice slurry has an effect on PAA efficacy. Sodium chloride or salt is typically used as the freezing point depressant in making the slurry. PAA contains acetic acid and hydrogen peroxide that naturally breaks down in water. However, when salt is added to the mix, the hydrogen peroxide in the PAA breaks down quicker. Therefore, the team will test the concentration of PAA in water over time versus in salty water over time to determine if there is any significant effect on PAA efficacy.

The team is also investigating carcass salt uptake to determine if there are any labeling implications based on current regulations imposed by the U.S. Department of Agriculture's Food Safety and Inspection Service (FSIS).

"In the long run, ice slurry could possibly become known as a natural sanitizing aid for poultry chilling," says Haynes.

The project was the basis for Richter's Master's thesis titled "Investigating Ice Slurry's Perceived Mechanical Abrasive Quality to Increase Pathogen Reduction on Poultry During Immersion Chilling." She says being able to work on such a large interdisciplinary project has afforded her the opportunity to learn skills outside of a traditional biology thesis.

"After working three years on the ice slurry project, I am proud to say I still eat chicken," says Richter.