Summary

Utilization of organic acids with chlorinated wash water for pathogen reduction on quail carcasses, using direct application methods that would be economically feasible for small and very small quail processors.

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Organic acid sprays on poultry carcasses have been shown to reduce the level of pathogens and total microbial numbers. An experiment was designed by the University of Georgia Food Science Extension Outreach Program to demonstrate the effectiveness of post-evisceration spray wash and a post-chill wash with peroxyacetic acid (180-200 ppm), lactic acid (2%), or hot water (170° F) on quail carcasses.

The objective was to develop pathogen reduction methods for use on quail through the use of organic acids, hot water, and chlorine in combination with phosphoric acid buffers (PBS). Agents will be applied post-evisceration and prior to chill by spray application available to small and very small processing plants.

Materials & Methods
Quail carcass samples: 10 sets of four birds for four test groups consisting of lactic acid spray, peroxyacetic acid spray, hot water, and control. A sample method selecting every fifth bird coming off the post-evisceration line/ pre-chill and post-chill was utilized. Birds were rinsed with water after taking the PBS sample and sent to the chiller. The hot water rinse was discontinued after the first trial.

Spray equipment: 2-4 gallon, hand-pump sprayer with fan nozzle, cost less than $100.

Chemicals used: Lactic acid (2%) – Lactic Acid 88% Food Grade from Fiseher Scientific, peroxyacetic acid (180-200 ppm) – (Inspexx 100) from Ecolab.

Treatment
The spray equipment was a pump-up sprayer at 20-30 psi pressure. A fan type nozzle achieved a uniform application of the solution onto the carcasses. This system could easily be automated to detect the presence of a carcass and activate the sprayer cut-off valve.

The organic acids were sprayed on the carcasses wetting all external skin surfaces and the body cavity for 15 seconds using a sweeping motion. The birds were allowed to drip for 30 seconds before taking the microbial test samples. The samples were placed in PBS sample bags with 100 ml PBS and shaken for 30 seconds. The carcasses were then removed from the bag, rinsed, and sent to the chiller. Samples were labeled for subsequent analysis.

Summary Analysis
The hot water wash was discontinued after the first round of testing because it degraded the carcass skin and discolored the meat.

Three trials using 2% lactic acid on quail carcasses pre- and post-chill resulted in a reduction of 2.0 to 2.5 log10 in aerobic plate count and 1.4 to 2.4 log10 reduction in *E. coli*, 10 CFU/ml. post-chill results. Post-chill results were not as great as the chill water chlorine had a 0.5 to 1.5 log10 reduction in both aerobic plate counts and *E. coli* over the pre-chill counts.
The lactic acid spray further reduced the counts by .05 to 1.3 log10 for aerobic plate count and E. coli CFU/ml over the control samples. Lactic acid has several advantages over peroxyacetic acid. It has a greater residual effect than peroxyacetic acid or cold water wash alone, gave better results, and is easier to handle and store. Peroxyacetic acid was not as effective as lactic acid in reducing the number of *Salmonella* positives.

The most significant change in reducing the numbers of positives for pathogens was the presence of free chlorine (> 5 ppm) in the chill water. The pre-chill wash should contain at least 40 ppm free chlorine to reduce the total microbial load. The number of positive *Salmonella* samples dropped from 58/60 found in the initial samples prior to the testing to 1/60 samples (30 pre-chill samples and 30 post-chill samples) in the final trial.

Recommendations
Include free chlorine (> 5 ppm) in the chill water. Free chlorine is a must in reducing *Salmonella* positives. The processing system must be monitored regularly and preventive measures in place to insure free chlorine is coming out of the chiller. The water overflow rate must also meet USDA requirements to control the organic material load **in the ~~wash?~~** ~~and~~ chiller water.

Benefits to Small/Very Small Plants
The spray equipment and the lactic acid are economical. The cost of lactic application per bird is approximately $0.00256 per bird for processed quail.
The system should improve the bacterial count by at least a 1 log reduction. The most critical factor, however, in reducing pathogens in the quail slaughter line is maintaining the proper amount of free chlorine in the wash and chill water.

Note to Dr. Reynolds:

1. Where are the chemicals available? Most industrial chemical companies carry lactic acid (88% food grade) and peroxyacetic acid in 55 gallon bulk drums. Smaller containers may also be available from chemical suppliers such as Fisher Scientific.
2. How much do they cost per unit? Bulk drum (55 gallon) of lactic acid costs approximately $800; 500 ml glass jug from Fisher Scientific costs $110, plus shipping. To achieve a 2% solution, add 2.5 oz lactic acid to one gallon of water. One gallon of 2% lactic acid solution will spray approximately 250 quail carcasses, 10 hogs or 5 beef carcasses. The 50 gallon drum of lactic acid costs approximately 64 cents per gallon at 2% solution.

   Peroxyacetic acid (or peracid) is also available in bulk from chemical distributors. This research project used a proprietary brand, Inspexx 100 from Ecolab, which lists at $1336.10 for 50 gallon drum (weight 476 lbs) (300 gallon bulk tank lists for $8334.90, per Ecolab pricing 1-800-352-5326. Contract price is generally somewhat lower.) The 180-200 ppm solution is achieved by mixing 20 mL of peroxyacetic acid to 5 gallons of water. One gallon will spray approximately 250 quail carcasses, 10 hogs or 5 beef carcasses. The 50 gallon drum of Ecolab's Inspexx 100 lists for $1336.10, which breaks down to less than 3 cents per gallon when mixed.

3. What size units do they come in? Lactic acid is available in bulk drums (50 gal.) weighing over 550 lbs. down to 500 ml in amber glass jars. Peroxyacetic acid is available in 50 gallon drums and 300 gallon tanks from Ecolab, other sizes may be available elsewhere.

4. Special handling instructions? MSDS sheet from supplier should be kept on file with HACCP records. Lactic acid must be stored in a cool, dry place, away from reactive materials such as nitric acid, strong oxidizing agents, strong reducing agents, iodides, or bases.
5. Any precautions? Avoid contact with skin and eyes/face. Wear long sleeves, gloves and eye/face protection. Be sure adequate ventilation in the usage area prevents build-up of CO2 fumes.

6. I presume they can get the sprayer and fan nozzle tips at most hardware stores? Pump sprayers and fan nozzles are available at most hardware stores for less than $100. Stainless steel is recommended. Pressurized systems with a continuous source of solution can be manufactured in-house or by a good mechanical contractor. A cut-off valve can be operated by an electric eye to detect the presence of a bird on continuous systems.

Revised summary emailed to Howard Early 8-2-05 ebm
Summary revised 8-24-05 per AER/ebm.
Supplemental procedure steps added 8-24-05 per AER/ebm
Entire report with calculations table emailed to Howard Early and Dr. Murthy 8-26-05 ebm

ADDED 8-24-05 per request of Dr. Murthy

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Steps in applying acids using spray method to reduce pathogens

Step 1

A. Purchase a two to four-gallon stainless steel or plastic pump-up hand sprayer which can be pumped up to 20-30 psi. Use with a fan nozzle to apply the acid spray solution.

B. Purchase food grade Lactic Acid (88%) from your chemical supplier.

Step 2

A. A solution of the chosen organic acid may be mixed directly in the sprayer. Be sure to follow the safety precautions given on the MSDS sheet when handling the chemicals.
Accuracy in measuring the acid concentrate is important, so measure the acid using a volumetric pipette sufficient to make TWO gallons of solution. Measure warm water (120°F) into the sprayer, then add the measured acid concentrate, close the sprayer and shake solution to mix thoroughly. Pump sprayer according to manufacturer's instructions to obtain 20-30 psi pressure.

B. For a 2% LACTIC ACID solution, measure five ounces (5.12 oz or 151.4 mL) of 88% Lactic Acid and mix into two gallons (7.5 l) of warm water (120°F) in the sprayer. Close the sprayer and shake to mix thoroughly. Pump sprayer to 20-30 psi.

Step 3

Spray hot poultry carcass prior to chill with lactic acid inside and outside (skin), thoroughly wetting the bird. Allow 15 seconds for the bird to drip and for the acid to be effective in reducing surface bacteria. The birds then enter the chill tank. Insure that the chill water has at least 5 ppm free chlorine at all times.

Step 4

Birds may be sprayed with (or dipped into) the lactic acid solution upon exiting the chiller tank. This will insure an additional 1.0 log10 reduction in the total APC on the birds and reduce the *Salmonella* sp. positives on the carcass. The lactic acid has an additional residual effect on the microbial counts on poultry carcass.

NOTE: Insure that ≥5 ppm of free chlorine is always available in the chill tank water. Test at regular intervals during processing with chlorine test strips available from your chlorine supplier. This insures that an effective reduction of microorganisms is occurring in the chill water.