American Scientific Forum focuses on some topical poultry meat issues

At the recent International Poultry Scientific Forum, held during the International Poultry Expo in Atlanta, several papers focused on topics that are relevant to the meat sector.

Bacterial contamination of raw chicken skin

Anita Menconi et al, University of Arkansas, Fayetteville, AR, USA.

Bacterial contamination of raw processed poultry can limit shelf-life and can include foodborne pathogens. This study evaluated different combinations of organic acid wash solutions for reductions in bacterial contamination of raw chicken and their effect on recovered cfu of pathogens and aerobic bacteria during cold storage.

In the first trial, raw chicken skin samples were dipped into a suspension containing either Salmonella typhimurium, E. coli O157:H7, or Listeria monocytogenes for 30 seconds and then immersed in either PBS or an organic acid wash solution mixture of 0.8% citric, 0.8% acetic, and 0.8% propionic acid (at equal w:v % concentrations) for an additional 30 seconds.

In the second trial, three different concentrations of the organic acid wash solution (0.2, 0.4 and 0.6% at equal w:v % concentrations) were tested against chicken skin samples contaminated with S. typhimurium. In both trials viable cells of pathogenic bacteria on each skin sample were enumerated after 1 and 24 hours of storage at 4°C.

In a third trial skin samples were initially treated on the first day with either PBS or two concentrations of the organic acid mixture (0.4 and 0.8%) and total aerobic bacteria were enumerated during a two week storage period.

In all these trials, significant ($p<0.05$) differences were observed when skin samples were treated with the organic acid wash solution and no spoilage organisms were recovered at any given time-point, while increasing log10 numbers of spoilage organisms were recovered over time in PBS treated skin samples.

These results suggest that 0.2-0.8% concentrations of an equal-percentage mixture of this organic acid combination may reduce pathogens and spoilage organisms and improve food safety properties of raw poultry. ■

Generation of airborne listeria from floor drains

Mark Berrang et al, USDA-ARS-Russell Research Center, Athens, GA, USA.

Listeria monocytogenes can colonise floor drains in poultry processing and further processing facilities remaining present even after cleaning and disinfection of the plant. Therefore, during wash down, workers need to exercise caution to prevent escape and transfer of drain microflora to food contact surfaces.

The objective of this study was to examine the extent to which an inadvertent water spray into a colonised floor drain can cause the spread of airborne listeria.

Non-virulent L. innocua was used to inoculate a PVC model floor drain resulting in approximately 100 million cells per mL of PBS and one million attached cells per cm^2 inner surface. Each model drain was subjected to a two seconds spray of tap water at 68.9 kPa from a distance of one metre. Airborne cells were collected by means of sedimentation plates filled with modified oxford agar which were placed on the floor and walls of a contained room at incremental horizontal and vertical distances of 0.6, 1.2, 2.4 or 4.0 metres from the drain.

Sedimentation plates were exposed for 10 minutes. A mechanical sampler was used to collect air by impaction on the surface of modified oxford agar to measure the number of cells per litre.

The study was conducted in triplicate rooms for each replication. Listeria was detected on sedimentation plates on walls as high as 2.4m above the floor and 4.0m from the drain.

Plates on the floor were less contaminated with increased distance from the drain – at 0.6m more than 50 cfus were detected, while at 2.4m an average of 2.6 cfu were detected. Plates set at the height of a low bench, 2.4m from the drain were also found positive for listeria.

Results from the mechanical air sampler revealed an average of 0.3 CFU per L of air.

A two second accidental spray with a water hose into a contaminated area can cause airborne spread of listeria resulting in the potential for cross contamination of food contact surfaces, equipment and exposed product. ■

Reducing C. jejuni populations on poultry

Jacob Smith et al, Auburn University, Auburn, AL, USA.

Current regulatory guidelines to control poultry borne pathogens, more specifically Campylobacter jejuni, warrant the need for novel applications of antimicrobials during poultry processing. The objective of this study was to evaluate the efficacy of 1,3-Dibromo-5,5-Dimethylhydantoin (DBDMH) as an antimicrobial intervention in reducing C. jejuni on fresh poultry.

Varying concentrations (0, 50, 75, 100, 200, and 300ppm) of DBDMH were prepared and chilled to 10°C. Broiler carcasses were inoculated with 10 mL of C. jejuni (approximately 7 log10 cfu/mL) and allowed 30 minutes for attachment.

Carcases were then subjected to either immersion or spray treatment of DBDMH. The immersion treatment was performed to determine impact of time of exposure of DBDMH on C. jejuni.

Following treatment the carcases were rinsed with 200mL of Buffered Peptone Water and 250µL of the rinsate was plated onto Campylobacter Cefex and plate count agar plates.

Campylobacter Cefex agar plates were incubated under micro-aerophillic conditions at 42°C for 48 hours and plate count agar media was incubated aerobically at 37°C for 24 hours.

Statistical analysis indicated that the immersion application significantly ($P\leq0.05$) reduced aerobic bacteria as compared to the spray application. Although reductions of C. jejuni were observed to be higher with increasing concentrations of DBDMH, results suggested that 300ppm DBDMH as an immersion application showed the greatest amount of reduction ($P\leq0.05$) of C. jejuni irrespective of the time of exposure.

A commercial chilling trial showed significant reductions ($P\leq0.05$) post-chill compared to pre-chill for both C. jejuni and aerobic bacteria. This study demonstrated that 1,3-Dibromo-5,5-Dimethylhydantoin can be used as an antimicrobial treatment on fresh poultry. ■

Improving tenderness and deboning yield

Laura Bauermeister et al, Auburn University, Auburn, AL, USA.

Poultry breast fillets need approximately 4-6 hours of post mortem aging prior to deboning to become tender, however this reduces the yield on the deboned breast fillets.

This study was designed to explore alternative treatments to aging to determine if fillet tenderness could be maintained while preserving the yield characteristics of early deboned product.

Whole chickens (n=200) were conventionally processed and randomly assigned to the following deboning treatments with 25 whole carcases per treatment and two replications; 2 hours aged Control (2hC), 2 hours aged injected with phosphate-A (Phos-A), 2 hours aged injected with phosphate-B (Phos-B), and 6 hours aged, Control (6hC).

The 2hC and the 6hC were aged on ice for 2 and 6 hours post mortem, respectively and deboned. The Phos-A and Phos-B treatments were aged on ice for 2 hours post mortem and injected with either 3.46% Phos-A or Phos-B and 3.83% salt, with a 10% uptake. pH and temperature of the marinade, fillet yield and % uptake, drip-loss, cook-loss and ready-to-cook yield were calculated and fillets were split into right and left halves.

Sensory testing was completed using the right fillet and an 8-point hedonic scale for appearance, flavour, tenderness, juiciness and overall acceptability. Left fillets were prepared identically to the sensory fillets for texture analysis and cook-loss was determined. Percent moisture was determined on raw and cooked meat samples.

There were no significant differences in the marinade pickup between the Phos-A and Phos-B, however; the product injected with the Phos-B did have an increased breast yield and ready to cook breast yield when compared to the other treatments.

In addition, the fillets from the carcases injected with the Phos-B had a lower drip loss and cook-loss when compared to the other treatments, which also attributed to the higher ready to cook breast yield. The sensory panel liked the flavour of the Phos-B more than the other treatments and also perceived the texture of the Phos-B treatment to be more tender than other treatments.

Overall, the early deboned chicken meat injected with the a Phos-B achieved a quality better than or equivalent to the 6hC breast fillets while improving the deboning and RTC yield and improving the sensory attributes of texture and flavour in the breast fillets. ■

Limit contamination in chill tanks

Brad Schambach et al, USDA-ARS-Russell Research Center, Athens, GA, USA.

The objective of this study was to assess the effectiveness of a proprietary chemical additive (T-128) to lower bacterial numbers in chill water and stabilise chlorine in the presence of organic material.

To test this, eight containers were prepared each containing a fresh broiler wing, water, and ice in a weight to weight ratio of 1:2:4 chicken meat to water to ice.

Two containers were assigned to each of four treatments, as follows: control (no additive), 50ppm chlorine, 0.5% T-128, and a combination of 50ppm chlorine and 0.5% T-128. All containers were covered with aluminium foil and shaken at 130 rpm for 45 minutes.

Water temperature, pH, free chlorine, and total chlorine were measured at the outset and after 45 minutes of chilling.

At time 0 and 45 minutes, one mL of chill water was plated on the surface of plate count agar. Plates were incubated for 24 hours at 37°C and the resulting colonies were counted.

This experiment was replicated five times resulting in a total of 10 samples for each of the four treatments.

After 45 minutes of shaking, the mean chill water temperature ranged from 0.6-0.8°C.

Mean chill water pH was as follows: control: 6.92, 50ppm chlorine: 7.08, 0.5% T-128: 3.10, and 50ppm chlorine plus 0.5% T-128: 3.85.

Mean free chlorine levels for these treatments after 45 minutes were: control: 0ppm, 50ppm chlorine: 3.01ppm, 0.5% T-128: 0ppm, and 50ppm chlorine plus 0.5% T-128: 2.84ppm.

Mean total aerobic bacteria counts per mL of chill water after 45 minutes were 213 colony forming units (cfu) in the control, 107 cfu in the chlorinated samples, 8 cfu and 10 cfu in the T-128 only and T-128 plus chlorine samples, respectively.

Despite the fact that after 45 minutes, samples containing T-128 had similar levels of active chlorine as chlorinated samples without the additive, those with T-128 had significantly lower ($p < 0.05$) chill water plate counts. In fact, samples containing T-128 by itself resulted in low bacterial numbers comparable to samples containing both T-128 and chlorine, and lower than samples containing only chlorine.

Further research is needed to determine if these results are due to T-128 interacting with chlorine or simply from the pH reduction caused by the addition of T-128 itself. ■

Strain and gender effects on broiler meat

Melissa Miller et al, Department of Animal and Dairy Science, University of Georgia, Athens, GA, USA.

The effects of strain and gender on meat quality of six commercial broiler strains were analysed. Broilers representing six strains from four male and three female parent stocks (M1×F1, M2×F1, M3×F1, M4×F1, M3×F2, M4×F3) were evaluated. The broilers were raised and processed (49 days) using current industry practices and carcases were chilled for at least 2 hours and deboned.

One breast from each carcase was used for quality evaluation. Breasts were frozen within 24 hours post mortem and stored at -20°C.

Frozen breasts were weighed, thawed overnight at 40°C, and reweighed to determine drip loss. Muscle pH was measured on the dorsal end and colour (L*,a*,b*) was measured on the internal surface of breasts. Breasts were then cooked to 75°C and cook loss was calculated. After cooling overnight, Warner-Bratzler peak shear force (kg/cm) was measured.

In terms of quality, M4 produced offspring with a lower (P=0.03) pH than M2; and tended to produce a lower (P<0.09) pH than M1 and M3. For colour, breasts from M2 progeny were darker (lower L*, P<0.03) than M1, M2, and M3 breasts and F1 offspring breasts tended to be darker (P<0.08) than F2 and F3 breasts. Breasts from M2 and M3 progeny were redder (higher a*, P<0.02) than M4, while F1 progeny breasts were redder (P<0.03) than F3 progeny. M1 and M3 progeny breasts were more yellow (higher b*, P<0.05) than M2 breasts. Males had higher (P<0.01) pH values than females and female broilers produced lighter (P<0.01), less red (P<0.05), and more yellow (P<0.01) fillets than males.

As expected, male breasts were heavier (P<0.01), had longer (P<0.01) cook times, and exhibited higher (P=0.01) cook losses than female fillets. F2 fillets were heavier (P<0.01) than F1 fillets and F3 fillets had higher (P<0.06) drip loss than F1 breasts.

Strain effects (P<0.01) on tenderness showed that breasts from M2, M3, and M4 broilers were similar in tenderness and less tender (P<0.01) than M1 breasts. F2 fillets were more tender (P<0.01) than F1, which were more tender (P<0.01) than F3 fillets.

Male fillets were more tender (P<0.05) than female. Strain and gender significantly influenced meat quality attributes including colour, pH, and tenderness along with breast weight and cook yields. ■