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August 2009

Project #F019

Validation and Feasibility Assessment of a Pulse Electric Field Scalding Tank to Inactivate Pathogens and Accelerate Rigor Mortis Completion

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"Use of Pulse Electric Field in Scalding Tanks to Reduce Pathogen Load"

Scalders and pickers are often the initial point of cross-contamination with pathogens such as *Salmonella* spp. and *Campylobacter* spp. in poultry processing plants. However, there are few antimicrobial interventions applied at this stage to minimize pathogenic loads. Chemicals such as chlorine may not be fully effective due to the high amount of organic material present in the scalding tank and the dissipation of chlorine gas under scalder conditions. Temperatures in the scalding operations are not sufficient to produce significant lethality, especially in soft scalding operations. A small scale poultry scalding/chilling tank system was assembled with the use of a pulse electric field generator (Model SF-700, Simmons Eng. Co., Dallas, GA) complemented with platinum electrodes and a pilot scale commercial scalding tank (Dunkmaster®, Knase Company Inc, MI). Experiments were carried out at the Microbial Challenge Pilot Plant of the Poultry Science Center at Texas A&M University. Marker strains of Novobiocin and Nalidixic acid resistant *Salmonella enterica* Serovar Typhimurium and *Salmonella enterica* Serovar Enteritidis strains as well as poultry-isolated *Campylobacter jejuni* cultures were used in numerous challenge studies evaluating the effects of Pulsed Electric Field (PEF) application on carcasses and scalder/chiller water pathogen contamination under commercial processing conditions and the effects of PEF on carcass rigor completion. The system was evaluated with 0, 0.5, and 1% sodium chloride dissolved in the water to enhance conductivity. The system provided up to 40 V and 0.54 Amps of electric current under the conditions evaluated; conditions aimed at minimizing risks of electric shock to the researchers during PEF application. Scalder water from a local poultry processing operation was collected and kept at 45± 2°C or 57± 2°C to simulate soft and hard scalding conditions, respectively. Chiller water trials were simulated using iced water and immersed pre-eviscerated, peeled carcasses. Tempered water was then inoculated with a cocktail culture of *Salmonella* or *Campylobacter* strains in separate trials to a level of 6.00 $\log_{10}$ cfu/ mL of water. Four different treatments were applied to the three conditions evaluated (soft scalder water, hard scalder water and chiller water in triplicate studies: 1) a control treatment with no salt and no electric treatment, 2) a PEF only water treatment, 3) a PEF treatment with 0.5% salt water; and 4) a PEF treatment with 1% salt water treatment. The PEF treatment consisted of a 10 seconds on, 5 seconds off cyclical pulses. Samples were collected at 0, 40, 80, 160 and 200 seconds of treatment and plated immediately in respective media for enumeration of surviving pathogen loads.

The use of PEF in regular hard scalding water (no salt, 57± 2°C) showed some effect on both *Salmonella* and *Campylobacter* reductions when compared to the control samples during the 200 seconds timeframe (~1.5 to ~4 log cfu/ mL of water, respectively). However, with the addition of salt, the intervention caused at least 2.6 and 5.0 $\log_{10}$ cfu/mL reduction of *Salmonella* and *Campylobacter* counts after 200 seconds of exposure, respectively. Similar findings were observed under soft scalding conditions (45± 2°C). All experiments were replicated under chilling conditions using the same equipment set-up. Overall *Salmonella* reductions in cold water (4± 2°C) ranged from

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0.7 for PEF only, 1.0 for PEF + 0.5% salt and 1.9 $\log_{10}$ cfu/mL of water for PEF+ 1% salt. Further trials with 25ppm of chlorine, PEF and 0.5% salt showed up to 3.6 $\log_{10}$ reductions in *Salmonella. Campylobacter* reductions were more evident under chilling conditions with up to 2.0 for PEF only, 5.0 for PEF + 0.5% salt and 3 for PEF + 1% salt $\log_{10}$ cfu/mL of water. Addition of 25ppm of chlorine to the chiller eliminated any remaining *Campylobacter* loads in the water. Experiments attempting to measure antimicrobial activity of the PEF system in carcass-filled scalders/chillers showed minimal effects on direct carcass contamination. In addition, the current set-up was not sufficient to exert any electric stimulation effect on carcass muscles or rigor completion**,** with no significant differences in shear force, cook loss and drip loss when comparing PEF treated carcasses and non-treated counterparts evaluated immediately after processing and subsequent to 6 hours of aging.

These results suggest that continuous treatment of the scalder/chiller water with the current PEF setting or more powerful systems can be successfully used to reduce pathogenic loads of *Salmonella* and *Campylobacter* that accumulate during processing. Since the water in a scalding/ chilling tank is constantly being recontaminated by the introduction of new carcasses at a rate of up to 120 birds per minute, this intervention can potentially reduce the overall contamination of clean carcasses with high pathogen levels when the water is recycled and re-introduced in the system after being treated. This intervention accompanied with water filtration can potentially assist processors in fulfilling the requirements for the use of recycled water in scalders/chillers, considering that the water reintroduced in the system will be microbiologically cleaner than the untreated water.

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