Final report **summary**

Sanitisers for commercial use in chicken meat production

Learn more
agrifutures.com.au/chicken-meat

AgriFutures® Chicken Meat

Abstract

Consumption of Australian poultry meat has risen more than 49% in the past 20 years, surpassing beef, pork and lamb. This increased popularity is linked with the retail price stability of chicken meat, which has not increased substantially over the same period. Broiler birds, however, often carry bacteria such as *Campylobacter* and *Salmonella* that are frequently the cause of human gastrointestinal disease. Thus, limiting foodborne bacteria on the surface of chicken meat is important to human health.

Currently, Australian poultry meat processing plants use chlorine as a carcass sanitiser to control foodborne pathogens. This study investigated the effectiveness of two santisers, peroxyacetic acid (PAA) and acidified sodium chlorite (ASC), as potential alternatives to chlorine. The effectiveness of PAA and ASC were assessed using whole bird carcasses obtained from two processing points (pre inside/outside wash and post spin chill), as well as a meat cut.

Different experiments conducted in this study suggest that ASC is efficient at reducing foodborne pathogens, however further research into the health and safety implications of this sanitiser in processing plants is necessary. The data obtained are useful for both processors and auditors, and provide evidence towards potential variation in processing requirements, which is essential to receive approval from the Controlling Authority.

Background

In Australia, there are no set ranges of specific foodborne pathogen counts (*Salmonella* and *Campylobacter*) on raw chicken meat. In humans, there is 5-50% probability of *Campylobacter* infection with a dose of 100 organisms; for *Salmonella*, the dose is less than 100 organisms. During processing, chicken carcasses can become contaminated with bacteria from feathers, skin and ruptured intestinal tracts [1]. Cross-contamination of carcasses can also occur during the different stages of processing [1, 2].

Australian poultry meat processing plants use several interventions to reduce bacterial contamination of chicken carcasses, including an inside/outside wash with water, chilling carcasses to 4 °C, and immersion chilling in chlorinated water [2]. The efficacy of chlorine, however, is dependent on organic load and total bacterial load [3].

Acidified sodium chlorite (ASC) and peroxyacetic acid (PAA) have been shown to reduce microorganisms linked with foodborne gastrointestinal disease [4, 5], and have been approved by Food Standards Australia New Zealand [6]. The focus of this study was to investigate the potential use of ASC and PAA at different stages in Australian poultry meat processing plants, and compare their efficacy with chlorine. The information presented in this summary and the related report will be useful for both the poultry industry and Australian regulatory authorities should the selection and implementation of an alternative sanitiser to chlorine be considered.

Objectives

The experiments performed in this study tested PAA and ASC as potential alternatives to chlorine. The experiments were designed to identify processing points where these sanitisers might be most effective. The study had two major objectives. The first was to individually test the ability of two different concentrations of both PAA and ASC at reducing bacteria found on the surface of whole chicken carcasses from both the pre-inside outside wash and post-spin chill processing steps. Post carcass cutting, the number of bacteria often increases on meat pieces. Thus, the second objective was to test the effectiveness of PAA and ASC on reducing bacteria on a chicken meat cut and determine the residual effect of each sanitiser over time. As part of these objectives, the effectiveness of both PAA and ASC was also compared with chlorine.

Research

Two concentrations of PAA (100 and 200 ppm) and ASC (450 and 900 ppm) were tested at two different temperatures for their ability to reduce bacteria on whole bird carcasses obtained prior to inside/outside wash and post immersion chill. Carcasses were obtained from two commercial poultry processing plants and were transported to the laboratory. Sanitiser experiments were performed immediately upon arrival. Prior to sanitisation, whole bird carcasses were assessed for the initial number of bacteria. Sanitisers were diluted to the appropriate concentration in 25-litre drums containing water at the desired temperature. Carcasses were washed in sanitiser with manual agitation. Following wash in either PAA, ASC or chlorine, carcasses were re-assessed for bacterial counts. Pre- and post-sanitisation counts of total bacteria and *Campylobacter*, and the prevalence of *Salmonella* were compared to establish sanitiser effectiveness.

Three concentrations of PAA (50, 75, and 100 ppm) and ASC (60, 112, and 225 ppm) were tested using chicken meat cuts. Skin-on, bone-in thigh cuts were used for these experiments. Sanitiser experiments were performed in the laboratory using 25-litre drums containing pre-chilled water. Cuts were either dipped or immersed for 10 seconds in sanitiser. The number of total bacteria and *Campylobacter*, and the prevalence of *Salmonella* were determined pre and post sanitisation, and then compared. The residual effect of PAA and ASC on thigh cuts was also investigated. Cuts were sanitised and then stored under refrigeration. Every 24 hours, a set of thighs was assessed for bacteria and results compared over time.

Key findings

Both concentrations of ASC and PAA significantly reduced total bacteria, *Campylobacter* and *Salmonella* on pre-inside/outside wash birds. No difference between PAA and ASC was observed on the reduction of total bacteria, but ASC was more effective at reducing *Campylobacter* and *Salmonella*. The reductions in total bacterial counts were greatest for 200 ppm PAA and 900 ASC. The reductions of *Campylobacter* were greatest for both 450 and 900 ppm ASC, and were significantly higher than chlorine. ASC 900 ppm was most effective at reducing *Salmonella*.

Experiments were also conducted with post-immersion spin chill carcasses. The greatest reduction of total bacteria was achieved by 900 ppm ASC. Both 450 and 900 ppm ASC eliminated culturable *Salmonella* from post-immersion spin chill carcasses. Both PAA and ASC exhibited a greater reduction of total bacteria than chlorine, but the differences were not significant. *Campylobacter* and *Salmonella* were most significantly reduced by ASC.

Lastly, experiments were conducted to test the efficacy of PAA and ASC on skin-on, bone-in thigh cuts. PAA at 100 ppm and ASC at 225 ppm were the most effective at reducing *Campylobacter*. Additionally, all wash treatments reduced *Salmonella*, but the greatest reduction was observed for ASC. ASC resulted in a greater reduction in total viable count and *Campylobacter* compared with chlorine. The residual effects of PAA and ASC on controlling *Campylobacter* and *Salmonella* on thigh cuts was also investigated. Both sanitisers maintained lower total viable counts on thigh cuts over time compared with water. Similar results were observed for *Campylobacter* and *Salmonella*.

Implications for industry

In 2020-21, the gross value of Australian poultry production was $2.937 billion [7]. It is important to maintain high consumer confidence in poultry meat products by minimising the risk of foodborne disease. Infection with *Campylobacter* or *Salmonella* can result in self-limiting gastrointestinal disease, but additional sequelae can also arise. The incidence of campylobacteriosis is sporadic, so it is difficult to put a value on the cost of infection. All outbreaks of *Salmonella*, however, have resulted in a direct cost of $23.8 million [8]. Controlling these foodborne pathogens on poultry meat is of economic importance to the industry.

In Australia, there is a lack of knowledge on the parameters and indications for use of non-chlorine-based treatments in the chicken meat industry. The data obtained in this study are useful for both processors and auditors, and provide evidence towards potential variation in processing requirements, which is essential to receive approval from the Controlling Authority.

The findings provide the evidence required to support application to the controlling authorities (regulators and possibly customers) that the change to current processing practices, in this case specifically the sanitisers used, is at least equivalent to what is prescribed in the Standard and results in a consistent and safe product.

Publications

McWhorter, A. R., Weerasooriya, G., Willson, N.-L., Chousalkar, K. K. (2021). Peroxyacetic acid or acidified sodium chlorite reduce microbial contamination on whole chicken carcasses obtained from two processing points. (In preparation)

McWhorter, A. R., Weerasooriya, G., Chousalkar, K. K. (2021). Peroxyacetic acid and acidified sodium chlorite reduce microbial contamination on chicken meat pieces. (In preparation).

References

1. Hardie, K. M., Guerin, M. T., Ellis, A., Leclair, D. 2019. Associations of processing level variables with *Salmonella* prevalence and concentration on broiler chicken carcasses and parts in Canada. *Preventive Veterinary Medicine* 168:39-51.

1. Cox, J., Pavic, A. 2010. Advances in enteropathogen control in poultry production. *Journal of Applied Microbiology* 108:745-755.

2. Muhandiramlage, G. K., McWhorter, A. R., Chousalkar, K. K. 2020. Chlorine induces physiological and morphological changes on chicken meat *Campylobacter* isolates. *Frontiers in Microbiology* 11:503.

3. Sexton, M., Raven, G., Holds, G., Pointon, A., Kiermeier, A., Sumner, J. 2007. Effect of acidified sodium chlorite treatment on chicken carcases processed in South Australia. *International Journal of Food Microbiology* 115:252-255.

4. Chousalkar, K., Sims, S., McWhorter, A., Khan, S., Sexton, M. 2019. The effect of sanitizers on microbial levels of chicken meat collected from commercial processing plants. International *Journal of Environmental Research and Public Health* 16:4807.

5. Food Standards Australia New Zealand. 2009. Food Standards Australia New Zealand. https://www.foodstandards.gov.au/Pages/default.aspx

6. Australian Chicken Meat Federation. 2020. Facts and Figures. https://www.chicken.org.au/facts-and-figures/. Accessed July 2019.

7. Ford, L., Haywood, P., Kirk, M. D., Lancsar, E., Williamson, D. A., Glass, K. 2019. Cost of *Salmonella* Infections in Australia, 2015. *Journal of Food Protection* 82:1607-1614

Acknowledgements

Funding for the project was obtained from AgriFutures Australia. Additional funds were obtained from the School of Animal and Veterinary Sciences, University of Adelaide, which contributed to the study investigating *Campylobacter* transcriptome post exposure to sanitisers.

The authors would like to acknowledge Dr Gayani Weerasooriya, Dr Nicky-Lee Willson, Dr Samiullah Khan, Shruti Kumar, Sonali Deshmukh and Siyuan Jia for their technical support during the wash experiments. We would also like to thank all the processing plant staff for their assistance with sample collection. Lastly, the authors would like to acknowledge the project steering committee members and Dr Margaret Sexton for their input.

Professor Kapil Chousalkar
University of Adelaide, Roseworthy Campus
Mudla Wirra Rd
Roseworthy SA 5371

08 8313 1502

AgriFutures®
Chicken Meat

AgriFutures Australia publication no. 22-011
AgriFutures Australia project no. PRJ-011593

Learn more
agrifutures.com.au/chicken-meat