

## Case Report

# Control of the Zoonotic Pathogen *Campylobacter* in the Food Chain

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### Abstract

*Campylobacter* is regarded as a leading cause of bacterial food borne infection in many areas of the world. *Campylobacter* enteritis in humans is characterized by a large number of sporadic cases rather than single-source outbreaks. Infection can be acquired by a number of routes. However, *Campylobacter* enteritis in humans is considered to be mainly food borne. Direct and indirect epidemiologic data indicate that poultry meat is the most important source of human cases of *Campylobacter* enteritis. This evidence provides the justification to focus control measures primarily along the poultry meat chain.

**Keywords:** Food Borne Infection; Bacterial Infection

### Farm level Interventions

Intervention at primary production has been proposed; aspects related to enhancing bio security at the farm level can be accomplished at relatively low cost (e.g., hand washing, fly screens, pest-proof buildings, and foot dipping). However, applying bio security interventions at poultry production sites has resulted in different levels of success in different countries [1,2]. Such variation may be attributed to differences in the *Campylobacter* loads in the poultry chain and environment. Hence, the effectiveness of bio security-related interventions in primary production should be based on a good understanding of the regional risk factors at the farm level. In addition, there are several intervention options for feed and water additives (e.g., organic acids, probiotics, short- and medium-chain fatty acids) [3]. However, the effectiveness of feed and water additives is variable for different products and is often difficult to reproduce, even in slightly different settings. The integration of multiple hurdles and management options at the farm level is necessary. Additional measures to be considered in the longer term include vaccination, phage therapy, and bacteriocins [3-5]. Considerable additional research on these strategies is needed to ensure the practicality, reproducibility, and efficacy of such approaches under field conditions.

### Processing Level Interventions

There is a need to apply interventions at the processing level in order to reduce contamination in products meant for human consumption. Highly contaminated samples have been associated with a higher probability of causing human illness [6,7]. Rosenquist et al. [8], using a risk assessment model, estimated that a 2-log reduction of *Campylobacter* counts on broiler carcasses would result in a significant reduction in cases of human *Campylobacter* enteritis associated with exposure to broiler meat. Freezing of contaminated poultry carcasses is a reliable intervention to achieve a 2-log reduction of *Campylobacter* counts. Compulsory freezing of processed broilers from *Campylobacter*-positive broiler flocks in Iceland resulted in substantially reducing the number of human cases of *Campylobacter* enteritis and is currently being used on a voluntary basis in Norway, Sweden, and Denmark [8, 9]. However, worldwide, many consumers prefer to buy fresh poultry meat with no change in product quality. In addition, freezing meat from all *Campylobacter*-positive broiler flocks might not be a feasible option in many countries, as it would limit the marketing of domestically produced chilled meat and increase dependence on imported product. This dilemma highlights the need to apply multiple hurdles during postharvest in order to achieve low counts of *Campylobacter* on chicken meat [10].

## Processing Hygiene Target

Results of current risk assessment models are in agreement in showing that reducing the numbers of *Campylobacter* on broiler meat is highly effective in reducing the burden of illness [7]. Because campylobacter enteritis is a leading food borne bacterial infection in many parts of the world, there is a need for setting targets (e.g., process hygiene criteria) for *Campylobacter* in the broiler meat chain. The setting of such targets would ideally be based on an associated risk reduction; however, it is seemingly not possible to consider a zero-tolerance policy or complete elimination of risk of campylobacter enteritis with respect to consumption of broiler meat.

## Physical Decontamination of Carcasses

Some alternative physical decontamination technologies may also achieve a reduction in *Campylobacter* numbers that is comparable to that obtained with freezing. For example, Corry et al. [11] determined that crust freezing of chicken carcasses (based on rapid ice crystallization on the “meat surface” that results in a thin frozen crust, followed by temperature equalization) could reduce *Campylobacter* numbers by 2 log CFU. However, Boysen and Rosenquist [12] reported that crust freezing of broiler carcasses provided only a 0.42-log CFU reduction in *Campylobacter* counts. Hence, the application of crust freezing needs to be optimized before it is widely adopted as a *Campylobacter* intervention. Another temperature-related intervention is the application of a steam-ultrasound treatment. Recent studies in Denmark revealed that this technology could reduce *Campylobacter* counts by 2.5 log CFU on broiler carcasses [12]. However, treated carcasses had the appearance of being slightly boiled [12].

## Chemical Decontamination of Carcasses

Chemical decontamination can also be an effective intervention for reducing the microbial load on carcasses. Chlorine, chlorine dioxide, acidified sodium chlorite, trisodiumphosphate, and peroxyacid are typically used in poultry processing in the United States either as sprays or washes for online reprocessing or added to the chill water tank to reduce microbial contamination and to limit the potential for microbial cross-contamination. Trisodium phosphate solutions of 8 to 12% can reduce *Campylobacter* counts on chicken carcasses by 1.0 to 2.0 log CFU [13, 14]. Treatment of chicken carcasses with chlorine compounds has also been extensively studied but with varying results, depending on the compound and treatment regime used in the processing plant. The use of electrolyzed water, of which hypochlorous acid is the principal active antimicrobial agent, has shown some degree of promise under experimental conditions in reducing numbers of *Campylobacter* on broiler carcasses but needs additional evaluation under processing facility conditions [15]. Lactic acid (2.5%) has been highlighted

as a cost-effective intervention strategy in a Dutch risk assessment study [7]. However, lower concentrations might be required, as the use of 2.5% lactic acid causes a yellow discoloration of the skin of chicken carcasses. Detailed research is still needed on appropriate treatment time and temperature and the effects of the food matrix on the antimicrobial activity of chemicals. In addition, more research may be needed on the toxicological, environmental, and food sensory aspects of chemical applications to carcasses.

## Conclusion

Research directions should focus on practical control options that would be appealing to stakeholders in the farm, slaughterhouse, and processing sectors. In addition, there are opportunities for the development of enhanced *Campylobacter* detection and quantification methods. Methods able to identify highly contaminated samples through online detection would be very useful, as this could help in identifying and excluding highly contaminated samples from the human food chain.

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