

5. Evaluation of likely outcomes of specific interventions

5.1 Step 1: Depopulate and transport to slaughterhouse

5.1.1 *Salmonella* and *Campylobacter*

The Experts found that there were no current quantified effects on prevalence or level of contamination of *Salmonella* and *Campylobacter* on broiler carcasses, and that the effect of any interventions made in the primary production stage had not been validated in a commercial setting. Therefore the evaluation of likely outcomes would not be measured as a reduction in prevalence or level of contamination, but have instead to be considered as a GHP, as described in Section 4.1, above. As mentioned in Section 4.4, Data gaps, there was a need for these measures to be quantified in order to consider these interventions as hazard reductions.

5.2 Step 2: Scalding, de-feathering and evisceration

5.2.1 *Salmonella* and *Campylobacter*

The measures mentioned in the Codex draft Guideline were found to cover the step adequately. No further data or interventions were presented at the Technical Meeting, and the interventions mentioned in the Codex draft Guidelines were not qualitative in regards to measuring the effect before and after the intervention.

5.3 Step 3: Washing and chilling

5.3.1 *Salmonella*

A study (Stopforth et al., 2007) showed 4–8% reduction in connection with sequential washing steps. However two other studies by Lillard (1989, 1990) (see Appendix) showed that reductions from sequential washing steps are not additive, since limited effects were obtained from sequential washings.

Furthermore, there was a documented effect of up to 100% when dipping the carcass in solutions containing a 10% solution of TSP at pH 12 for 15 seconds (Codex draft Guidelines).

Unpublished data were presented and validated at the FAO/WHO Technical Meeting, concerning the use of ASC (750 ppm, pH~2.5 spray application) in an OLR application. In plant trials, the reduction was a decrease the prevalence from 48% or 56% to zero. Additional unpublished data showed reductions of 18.4% in *Salmonella* prevalence by the use of ASC spray wash (700–900 ppm, pH ~2.5).

ASC can also be used as a pre-chill 15-second spray washing or a 4–8-second immersion dip, which has shown to reduce *Salmonella* on poultry carcasses by more than 2 log₁₀ cfu/ml of whole carcass rinse sample. If this is preceded by a freshwater wash, reduction can be increased to 2.6 log₁₀ cfu/ml whole carcass rinse sample.

The use of air chilling can minimize the growth of *Salmonella* if present, possibly due to a reduction in the carcass temperature. In the case of water chilling, use of chlorine in the water at a level of 5 ppm may reduce the *Salmonella* on broiler carcasses by 2 log₁₀ cfu/ml whole-carcass rinse sample.

Additional data were presented at the Technical Meeting, showing a reduction in *Salmonella* prevalence from 16% to 0% when using ASC (750 ppm, pH ~2.5, immersion dip, post-chill

application) (Bernard and Natrajan, pers. comm.), and a 15–25% reduction in *Salmonella* prevalence by the use of a chlorine dioxide generating system applied as a dip at 5 ppm post chill (Sanchez-Plata, pers. comm.).

5.3.2 *Campylobacter*

Campylobacter prevalence will be reduced by each individual wash step. Chlorinating the wash water, e.g. 25 ppm, has been shown to reduce *Campylobacter* levels on skin by 0.5 log₁₀ cfu/g. *Campylobacter* levels on the carcass can be reduced by a pre-chill 15-second spray washing or 4–8-second immersion dip. Reductions for *Campylobacter* can be up to 2 log₁₀ cfu/ml of whole-carcass rinse sample, and 2.6 log₁₀ cfu/ml whole-carcass rinse sample if the spray is preceded by a freshwater wash.

Forced air chilling can also be a hazard reducing control measure for *Campylobacter* due to the drying out of the surface. This measure can reduce *Campylobacter* by 0.4 log₁₀ cfu/g.

Besides the abovementioned interventions, new studies have shown that crust freezing using CO₂ as mentioned in Chapter 4 could reduce *Campylobacter* by 0.42 log₁₀/g (Boysen and Rosenquist, 2009; Corry et al., 2003)

5.4 Step 4: Storage, retail and consumer handling

5.4.1 *Salmonella*

Cooking to a minimum internal temperature of 74°C will give a 7 log₁₀ reduction in *Salmonella*.

5.4.2 *Campylobacter*

No specific hazard reducing measures have been described in the Codex draft Guidelines regarding this step, but the Experts recommended the Codex working group to consider a study showing that the use of high oxygen concentration (70%) reduced the survival of *Campylobacter* during chilled storage by 2.0 to 2.6 log₁₀ over 8 days of storage (Boysen, Knøchel and Rosenquist, 2007). Also, freezing followed by 31 days of storage at -20°C has shown to have a reducing effect on *Campylobacter* prevalence in naturally contaminated carcasses (by 0.65 to 2.87 log₁₀ cfu/g) (Codex draft Guidelines).

Cooking to a minimum internal temperature of 74°C has shown to give a 7 log₁₀ reduction in *Campylobacter*.