The impact of slaughter processing on *Escherichia coli* and cephalosporin-resistant *E. coli* counts on broiler chicken carcasses

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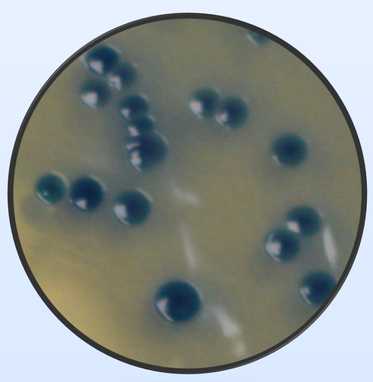


E. coli on HECA

Introduction

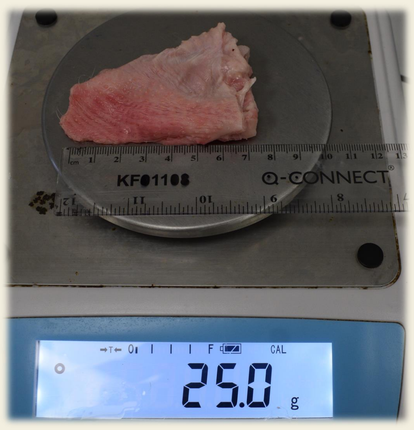
Antimicrobial resistance bacteria (AMR) is a major threat to humans and animals. Cephalosporins are critically important drugs for treating certain types of human infections. Research showed the death of 1.27 million humans due to antimicrobial resistance bacteria, and 4.95 million deaths were associated with antimicrobial infection (Murray et al., 2022). Retail chicken meat has been found as a source of AMR *E. coli* and cephalosporin-resistant *E. coli* in the UK, and more globally (Randall et al., 2020; Casella et al., 2018). Ultrasound is a non-thermal intervention treatment used in the decontamination of meat products, as it is significantly effective in reducing bacteria (Al-Hilphy et al., 2020).

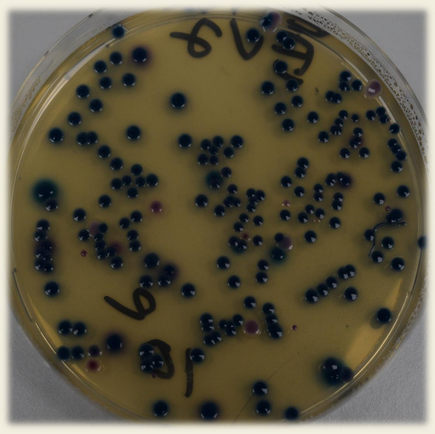
The aim of this study • To investigate the impact of slaughter processing on the numbers of *E. coli* and cephalosporin-resistant *E. coli* isolated from chicken neck skin at four slaughter processing points (post-defeathering, post-evisceration, post-intervention (ultrasound), and post-chilling.

ESBL producing *E. coli* confirmation according to EUCAT 2020

Materials and Methods

- In total, 230 chicken neck skin samples were collected at four different slaughter steps from six different batches (six processing days,), i.e. ten per processing step (post-intervention samples were not taken on one day due to technical difficulties) and transferred to the laboratory.
- 25 gr of neck skin mixed with BPW and homogenised for 60 sec.
- Serial dilutions were prepared and 0.1 µL plated evenly by the spreader on Harlequin (HECA) / Harlequin with cefotaxime (HECA+CX) and incubated at 37°C for 18-22 hours
- Extended Spectrum β-lactamase (ESBL) production was confirmed according to EUCAST 2020 guidelines
- Other lab work under performed: Antimicrobial Susceptibility Test, PCR, and Whole genome Sequencing.
- Methodology based on FSA, 2018, and EU protocol December, 2017





Results

- Both *E. coli* and cephalosporin-resistant *E. coli* counts decreased significantly along the slaughter processing between the post-defeathering and post-chilling.
- Overall, *E. coli* levels decreased from 4.11±0.67 $\log_{10}$ CFU/gr to 3.04±0.60 $\log_{10}$ CFU/gr of neck skin (significant reduction of 1.07 $\log_{10}$, $p<0.001$).
- Cephalosporin-resistant *E. coli* levels decreased from 2.36±0.29 $\log_{10}$ CFU/gr to 0.24±0.80 $\log_{10}$ CFU/gr of neck skin (significant reduction of 2.12 $\log_{10}$, $p<0.001$).
- The highest individual reduction effect in *E. coli* counts was observed post- ultrasound intervention, from 4.32±0.75 $\log_{10}$ CFU/gr to 3.60±0.63 $\log_{10}$ CFU/gr of neck skin (reduction of 0.72 $\log_{10}$, $p<0.001$).
- Similarly, ultrasound intervention significantly reduced counts of cephalosporin-resistant *E. coli*, from 2.44±0.32 $\log_{10}$ CFU/gr to 1.63±0.84 $\log_{10}$ CFU/gr of neck skin (reduction of 0.81 $\log_{10}$, $p<0.01$).
- Chilling was found to have slightly lower, but still significant reduction effect on *E. coli*, from 3.60±0.63 $\log_{10}$ CFU/gr to 3.04±0.60 $\log_{10}$ CFU/gr of neck skin (reduction of 0.56 $\log_{10}$, $p<0.001$).
- On the other hand, cephalosporin-resistant *E. coli* were greatly reduced, from 1.63±0.84 $\log_{10}$ CFU/gr to 0.24±0.80 $\log_{10}$ CFU/gr of neck skin (reduction of 1.39 $\log_{10}$, $p<0.001$).
- Evisceration increased carcass contamination slightly. *E. coli* and cephalosporin-resistant *E. coli* counts increased during evisceration from 4.11±0.67 $\log_{10}$ CFU/gr to 4.33±0.75 $\log_{10}$ CFU/gr, and from 2.36±0.29 $\log_{10}$ CFU/gr to 2.44±0.32 $\log_{10}$ CFU/gr of neck skin, respectively (both $p>0.05$).

Slaughter batch	Processing step	*E. coli*		Cephalosporin-resistant *E. coli*	
		$\log_{10}$	P value	$\log_{10}$	P value
All batches	Post-defeathering to post-evisceration	+0.214	0.1748	+0.077	0.364
All batches	Post-evisceration to post-intervention	-0.724	P<0.0001	-0.805	0.0018
All batches	Post-intervention to post-chilling	-0.565	P<0.0001	-1.39	0.0005
All batches	Post-defeathering to post-chilling	-1.075	P<0.0001	-2.11	P<0.0001

Table 1: Changes in *E. coli* and cephalosporin-resistant *E. coli* counts during slaughter processing. P-value <0.5 indicate the statistical significance

Conclusions

- Ultrasound intervention is effective in reducing *E. coli* and cephalosporin-resistant *E. coli* counts on chicken carcasses (up to 0.8 $\log_{10}$).
- This, alongside sequential use of chilling showed overall reduction effect of around 1 $\log_{10}$ for *E. coli* and around 2 $\log_{10}$ for cephalosporin-resistant *E. coli*.
- This indicates that the chicken slaughter processing that incorporates one interventions step is effective in reducing the spread of cephalosporin-resistance and antimicrobial resistance *E. coli* in broiler chicken meat chain.

References

- Al-Hilphy et al., J. Food Sci., 2020
- Casella et al., J. Antimicrob. Chemother., 2018
- Murray et al., Lancet, 2022
- Randall et al., J. Appl. Microbiol., 2020