Monitoring of campylobacters in UK poultry carcasses and collection of information from primary production and processing for risk factor identification

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In collaboration with the Department for Environment, Food and Rural Affairs, the British Poultry Council, the National Farmers Union and the British Retail Consortium we agreed a voluntary target for the reduction in the levels of Campylobacter in UK produced raw chicken to be achieved in a phased approach by the end of 2015.

This target was measured as a reduction from a baseline level of 27% of highly contaminated batches in 2008 to 19% by 2013 and to 10% by 2015. The Agency and industry needed to assess progress towards the target. Industry had put in place an on-going voluntary monitoring programme that could be utilised for this purpose.

Research approach

This study aimed to collect UK poultry processing industry Campylobacter test result data and investigate how to utilise these data to monitor progress against the voluntary target agreed with industry. This included assessing any implications for using three pooled neck skins from three birds as the test matrix for Campylobacter as compared with neck skins and breast skin from a single bird. The quality of the test data was also assessed using applied statistical methodologies and support was provided, where required, for laboratories to improve performance.

Eight sets of quality assurance determinations using standardised test samples of increasing complexity were undertaken. Previous Agency-funded work using campylobacters on neck skins indicated that pipetting and stomaching are two aspects of testing that contribute disproportionately towards larger measurement errors. Selecting samples that require increasing amounts of processing (e.g. more pipetting, vortexing or stomaching) can provide clues that point to any disproportionately large sources of uncertainty when compared with previous measurements.

Information was also gathered that describes processing and other practices, for example, overnight cleaning regimes in chicken broiler slaughterhouses. Using multivariate analysis, this information was used to identify those processing practices, if any, that have an influence on Campylobacter numbers on post-chill broiler carcasses in UK plants. This was achieved by developing a system based on the chicken broiler slaughterhouse assessment tool questions available from the Agency's slaughterhouse hygiene tool (project FS241018).

Results

The standard test for industry-funded testing for campylobacters is five samples each consisting of three pooled neck skins collected after carcass chilling. The study assessed the implications of changing the test sample from neck to breast skin. The numbers of campylobacters in breast skin were determined to be significantly higher (t-test, $P<0.05$) on neck skin compared with breast skin. There was no correlation between neck and breast skin Campylobacter numbers.

Between July 2011 and June 2014, over 25,000 Campylobacter test results were collected from 22 poultry processing plants and stored in a relational database. The data revealed that geometric mean numbers of campylobacters on chicken carcass neck skins increased over the duration of the study.

The quality of the industry-provided Campylobacter test results was assessed by eight rounds of proficiency testing. Each round had between 16 and 23 participating laboratories. A range of proficiencies was observed. Commonly-encountered issues included false-positive and - negative results reporting and an inability by some laboratories to consistently convert raw plate counts into reportable numbers of campylobacters. Data from poorly-performing labs was excluded from the results database. Six staff members from underperforming contract labs were retrained by the Bristol laboratory. Supervisors in 20 laboratories made use of exercise problems (and fully-explained answers) that were prepared to teach the conversion of raw counts to reportable numbers. Four processing companies changed their testing laboratory as a consequence of poor performance over several rounds of proficiency testing.

Online, validated data entry forms protected by secure login were created using the .NET programming framework to capture information describing the growing of broilers on farm and conditions in the plant during processing. The processing conditions data was more detailed than the farm information. Reports that summarised the collected information were created and made available to project partners and industry. The farm and plant information was used to construct a multi-level, Poisson model that attempted to predict the numbers of campylobacters on neck skins. The model revealed that there were nine units of variation that determined Campylobacter load on carcasses. On farm growing practices accounted for 7/9 of the observed variation, with processing plant activities accounting for the remainder.

During processing, the timely repair of a failed inside-outside washer ($P=0.05$), the temperature of the carcass after chilling ($P=0.032$), meeting the pluck effectiveness target ($P=0.0082$), meeting the chiller cleaning frequency target ($P=0.018$) and the season of sample collection [cos(day number) $P=0.018$; sin(day number) $P=0.00052$)] were identified as factors that influenced Campylobacter numbers on neck skins. A separate presence-absence (binomial) model confirmed the importance of on-farm factors compared with processing conditions for the presence of campylobacters on carcasses. A key recommendation of the study was that more information relating to bird growing was required to identify on-farm risk factors for bird colonisation by campylobacters.

Research report
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