A meta-analysis study of the effect of chilling on prevalence of microbiological indicators on pig carcasses

Donal Bergin¹; Francis Butler¹

¹ Biosystems Engineering, UCD School of Agriculture, Food Science and Veterinary Medicine, University College Dublin, Belfield, Dublin 4, Ireland. (donal.bergin@ucd.ie, francis.butler@ucd.ie)

INTRODUCTION

Meta-analysis refers to ‘the statistical analysis of a large collection of results from individual studies, such as experimental studies, opinion surveys and casual models, for the purpose of integrating the findings’ [3]. Previously meta analysis have been used widely in combining single, separate epidemiological studies focusing on certain study questions [4]. The objective of this study is to demonstrate that meta-analysis can be used to summarize individual abattoir prevalence to highlight variation between abattoirs effect of chilling on the prevalence of the indicator organisms, in a key stage within the pork processing chain. A traditional parametric approach of meta-analysis (which is widely used in meta-analysis of clinical trials) with the purpose of synthesising findings of prevalence studies of pathogens within the food processing chain was used. Specifically, this study aimed (i) to investigate whether there is support in the sampled population of studies for the causal inference that the chilling stage within pork production had a statistically-significant decreasing effect on Microbial indicators prevalence of pig carcasses; and if so, (ii) to estimate the overall effect of the chilling operation on the studied outcome. To emphasize the importance of selecting the appropriate statistical standardisation to measure effect size This approach was previously explained by Gonzales Barron et al. 2008 [1].

MATERIALS & METHODS

A search of electronic resources and non-electronic resources across a broad spectrum was conducted to locate studies detailing data on the occurrence of microbial indicators on pork carcasses pre and post refrigeration during processing. The combined search terms resulted in a total of 15 papers featuring 25 different abattoirs. Meta analysis was then carried out on this data using the data obtained from the search. A natural log of RR was utilized as the standard effect measure to test if there is a significant effect (U statistic) of Chilling on microbiological indicators prevalence. Subsequently, the effect size of individual surveys is estimated.

RESULTS & DISCUSSION

For the three indicator organisms examined (Enterobacteriaceae, Coliforms and Escherichia), the overall fixed effect (Log-RR) was significant (list the three log rr). As the overall effects were negative, this indicates that refrigeration has a beneficial but modest effect on reducing the prevalence Microbial indicators present on post chill pork carcasses. In all cases, A significant Q statistic was produced (Ecoli 47.95, Coliforms 23.74 and Enterobacteriaceae 184.03 P < 0.01) indicating that heterogeneity was detected, meaning that there was a variation between individual surveys which should be considered. Thus the random model was used to
account for between study variability with the standard error weight values of individual studies recalculated. Individual study estimates and overall fixed effects are presented with 95% CI (figure 1). The circular marker size represents relative weight ($\omega_i$) given to individual studies. Meta-analysis has confirmed that chilling can be an effective control Microbial indicators when the operation is properly undertaken, as the Overall effect $\theta$ on all three indicators produced were negative (showing a beneficial effect on the prevalence on pig carcass surfaces) –0.455 with a standard error of 0.2192 for E-coli, -0.269 with a standard error of 0.1467 for coliforms and -0.374 with a standard error of 0.1666 for Enterobacteriaceae. From the studies analysed these results indicate that conventional water treatment methods reduced microbial indicator occurrence in post chill pig carcasses by an average factor of 1.24 for E-coli, 1.15 for Coliforms and 1.19 for Enterobacteriaceae.

**Figure 1**: Difference in probability of Escherichia coli (left) and Coliforms (right) presence between chilled pig carcasses ($p_T$) and pre-chilled pig carcasses ($p_C$).

**CONCLUSION**

The outcome demonstrates that good hygiene practice is important in controlling indicator organisms and by inference pathogen prevalence during carcass refrigeration. This work demonstrated that meta-analysis can be used to summarize individual studies of indicator organisms’ prevalence in a key stage within the pork processing chain.

**REFERENCES**