

#1447 Visual-only meat inspection of pigs fattened outdoors: a food safety risk?

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Abstract

The primary purpose of meat inspection is to contribute to the production of safe food for human consumption. The aim of this study was to investigate whether the implementation of modern, predominantly visual, inspection systems for carcasses from fattening pigs reared outdoors since weaning, in Great Britain (GB), would alter the risk to food safety. A combination of sources was used to inform a formal, mostly qualitative, risk assessment, based on Codex Alimentarius Commission (CAC) guidelines. These sources included: a retrospective analysis of meat inspection data; a field trial of visual inspection of pigs from non-controlled housing conditions; previous work, scientific literature and publically available information. It was concluded that the public and animal health risks associated with endocarditis changed from negligible to non-negligible (i.e. very low) and the risk of microbial contamination of carcasses may be reduced.

Introduction

In order to determine whether a carcass is fit for human consumption, traditional methods of meat inspection use observation, palpation and incision with a focus on the detection of gross lesions. These methods may not be suitable for detecting some of today's important food-borne microbial pathogens and they may contribute to cross-contamination of carcasses. Derogations from European Union (EU) regulations have enabled carcasses of fattening pigs to be inspected by visual-only methods, provided that certain requirements are met, and the pigs have been reared under controlled housing conditions, in integrated production systems, from weaning to slaughter (Anon. 2004). However, uptake of modified inspection programmes has been low with only three EU member states reporting implementation (Alban *et al.* 2011). One of the reasons for low uptake within the British pig industry is that slaughterhouses accept a mixture of indoor and outdoor reared pigs throughout the day; the latter are from non-controlled housing conditions and still need to be inspected by traditional means. In previous work by Hill *et al.* (2013), it was determined that the overall risk, from all hazards to public health, was negligible for all pigs if a visual-only inspection method was used. Despite this, there was still a concern that the implementation of such inspection systems may not be appropriate for carcasses from fattening pigs reared, since weaning, in outdoor management systems, due to increased variability in the epidemiology, occurrence and control of diseases on these units. But is this the case?

The aim of this study was to investigate whether the implementation of modern, predominantly visual, inspection systems for carcasses from fattening pigs reared outdoors since weaning in Great Britain (GB) would alter the risk to food safety. This was achieved by addressing the following four questions: firstly, does the prevalence of conditions observed at traditional meat inspection vary between fattening pigs reared from weaning to slaughter, under controlled housing conditions, in integrated production systems, and those reared in outdoor management systems? Secondly, does the frequency of conditions observed in carcasses of fattening pigs, reared from weaning to slaughter in outdoor management systems, vary when inspected using visual-only inspection compared to traditional methods? Thirdly, does the level of microbial contamination of these carcasses vary when inspected using visual-only inspection compared to traditional methods? And, finally, will the risks from hazards to public health change if visual-only inspection for fattening pigs from non-controlled housing conditions was implemented?

Material and Methods

To answer the first question, a year's worth of ante-mortem and post-mortem carcass inspection plus post-mortem offal inspection data for fattening pigs slaughtered at the study abattoir were acquired. These were combined with information about the management systems from which the pigs originated i.e. indoor or outdoor systems. The frequency (prevalence) of each condition in each batch and the proportion of the batches affected with a condition were calculated and then compared (confidence intervals and Z-test). Effects of batch size and season were investigated by comparing odds ratios (Mantel-Haenszel). The batches in which the conditions were found were also compared for the two finishing systems (mean prevalence - t-test).

To answer the second and third questions, a field study was implemented over five separate weeks of work in the study abattoir during the period from November 2011 until April 2012. Carcasses from fattening pigs, which were reared from weaning to slaughter in outdoor management systems, were inspected using both post-mortem inspection methods. The

number of carcasses affected by each condition was recorded at a batch level. The baseline of type, frequency and distribution of conditions detected by both post-mortem inspection methods was established and then compared (normal distribution - paired t-test and Pearson's correlation test; season effect - linear models; non-normal distribution - categorised as 'absence' or 'presence' for each batch and McNemar test). Bonferroni corrections were used to adjust the threshold level for statistical significance in all relevant statistical analyses, due to the number of analyses performed in the comparisons.

Sponge swabs were used to collect samples for microbiological investigation from a subset of the above carcasses, after visual-only inspection and after traditional inspection, using a systematic random sampling strategy. The sampling methodology followed that described in Regulation 2073/2005. Samples were not intentionally taken from the same carcass after both inspection methods. Samples were processed in the laboratory 24 hours after collection in the abattoir. Total aerobic plate count, *Enterobacteriaceae* count, and *Salmonella* spp. isolation were carried out using the following methods:

1. Total aerobic plate count - BS EN ISO 4833:2003
2. *Enterobacteriaceae* count - BS EN ISO 21528-2:2004
3. *Salmonella*: Isolation of *Salmonella* - BS EN ISO 6579:2002

Yersinia spp. isolation was carried out using the following methods:

4. British Standards Institution (2003b) - BS EN ISO 10273:2003
5. Health Protection Agency (2011c). Detection of *Yersinia* species. Microbiology Services. Food, Water & Environmental Microbiology Standard Method F33: Issue 1.0.

The mean of the microbial counts with their 95% confidence interval (C.I.) were calculated for both inspection methods and then compared. For total aerobic plate count the estimates calculated were the mean of the logs, compared by student t-test. For the *Enterobacteriaceae* count the estimates were the mean of the values. Due to a large number of zeros, this variable was categorised as presence/absence and compared with a chi-squared test. Samples with more than zero *Enterobacteriaceae* plate count were transformed to \log^{10} and the means compared between the inspection methods (student t-test). Linear models were also applied. Other variables included in the models were inspection method, week, date and line position. The variables were selected to enter in the multivariable model if $P < 0.15$. This approach was also used for the binary variable: presence/absence of *Yersinia* spp. Bonferroni corrections were used to adjust the threshold level for statistical significance in all relevant statistical analyses, due to the number of analyses performed in the comparisons. Bonferroni corrections were used, as above.

To address the final question - will the risks from hazards to public health change if visual-only inspection for fattening pigs from non-controlled housing conditions was implemented - the outcomes from the investigations outlined above were used with previous work, scientific literature, and publically available information to inform the mostly qualitative risk assessment, using a modified CAC approach (CAC 1999). Hazards were identified then characterised; the characteristics of each organism when ingested by humans were described. Occupational hazards were not considered. In addition, the general characteristics of the hazard in pigs were described. For exposure assessment, the contribution of pork meat to the total public health exposure to organisms that are associated with the identified hazards was explored. The risk that exists when outdoor pigs are inspected by traditional methods was then characterised by integration of hazard identification, hazard characterisation and exposure assessment to obtain a risk estimate. This was then compared to the risk that exists when outdoor pigs are inspected by a visual-only method. In addition to the food safety aspects (public health), animal health and welfare were considered.

Results

The analysis of the historic traditional inspection records included data from more than 1.2 million pigs from approximately 7,400 batches (the groups that they are submitted to the abattoir in). These pigs came from both indoor and outdoor rearing and fattening systems, with the latter accounting for approximately a quarter of the batches. Batch size and seasonality had no influence on the associations found. The prevalence of conditions detected on traditional inspection of pigs submitted to slaughter from the two different fattening systems were similar. Statistically significant findings were as follows:

- a higher percentage of indoor batches were recorded as affected with 'tail bite', 'lameness', 'oedema', and 'pericarditis' than outdoor batches;
- a higher percentage of outdoor batches were recorded as affected with 'hair contamination' and 'milk spot' than indoor batches;

- the mean prevalence of ‘milk spot’ was higher, in the batches in which the condition was present, in those batches from outdoor systems, compared to indoor systems;
- the mean prevalence of ‘kidney pathology’, in the batches in which the condition was present, was slightly higher for indoor pigs than for outdoor pigs; whereas for ‘hepatitis’, ‘peritonitis’, ‘pneumonia’ and ‘other pathology’, the reverse was the case.

In the field study, more than 11,000 carcasses of fattening pigs from non-controlled housing conditions from 62 batches and 12 farms were inspected. No effect of season and farm of origin were found. There were statistically significant differences in the frequencies found by the two inspection methods for six of the categories of conditions. However, the biological differences were very small. Hair contamination of carcasses was recorded at higher frequencies with the visual method of inspection than with traditional inspection. The recorded frequencies were higher with the traditional method of inspection for milk spot, renal pathology, enteritis, pluck pathology and faecal contamination, than with visual only inspection.

For total aerobic plate count, *Enterobacteriaceae* count and *Salmonella* spp. isolation, 800 swabs were taken (400 after the traditional inspection point and 400 after the visual-only inspection point). For the *Yersinia* spp. isolation a slightly different subset of carcasses was sampled. In the whole study 759 swabs were tested for *Yersinia*: 379 after traditional inspection and 380 after visual-only inspection. No *Salmonella* spp. were isolated from any sample in the study. In addition, no statistical difference was found in the proportion of carcasses contaminated with *Yersinia* spp. after the two inspection methods. Although there was no evidence for a difference in the general bacterial contamination of carcasses after the two inspection methods, for the carcasses where *Enterobacteriaceae* were present there was some evidence that the level of contamination of carcasses was lower after visual-only inspection compared to traditional inspection.

Of the five public health hazards that we identified (endocarditis [*Streptococcus* spp., including *S. suis*, & *E. rhusiopathiae*]; granulomatous lesions [*Mycobacterium* spp., *Rhodococcus equi*]; *Salmonella* spp., *Yersinia* spp., and the hygiene process indicators [total aerobic plate count and *Enterobacteriaceae* count], only two have a revised risk on a change in inspection method; the risk associated with endocarditis (inflammation of the internal lining of the heart), changed from negligible to non-negligible i.e. very low; and, it is possible that the risk of microbial contamination of carcasses with *Enterobacteriaceae* is reduced. Only two animal health hazards were identified and assessed (endocarditis and granulomatous lesions). Again, endocarditis has a revised risk on a change in inspection method from negligible to non-negligible i.e. very low.

Discussion

Most of the differences found in the historic data analysis were predictable from knowledge of the housing, management and fattening systems used and their relationship with the diseases, or circumstances from which the conditions arise.

The field trial outcomes on observation and recording of conditions using the two different inspection methods can be explained by the positioning of the visual-only inspection point on the line, the truly ‘hands-off’ nature of the visual-only inspection and the lack of incisions into offal with this method.

The lack of isolation of *Salmonella* spp. was slightly unexpected and further work is planned to determine if this was truly the case. The hygiene processes on the line were observed to be good and this is reflected in the outcomes from the hygiene process indicators. Nevertheless there was still some evidence for a reduction in the contamination of carcasses by changing the *post-mortem* inspection method to a visual-only system where handling of carcasses by official personnel was minimised. It is possible that a change in the inspection method from traditional to visual would lead to reduced microbial contamination of carcasses in any abattoir with a level of contamination as low as, or higher than, the study premises. If the level of contamination of carcasses is reduced by a change in inspection method, then it could be hypothesised that the potential for cross-contamination would also be reduced; however, we cannot draw that as a conclusion from our study.

Despite the revised risk classification for public and animal health attributable to endocarditis for visual- only inspection compared to traditional inspection for outdoor pigs, the fact still remains (Hill *et al.*, 2013) that outdoor pigs from non-controlled housing conditions present at least the same, if not less of a risk than indoor pigs from controlled housing conditions.

Conclusion

The main conclusion is that the public and animal health risks associated with endocarditis would change from negligible to non-negligible (i.e. very low), if visual-only inspection for carcasses from fattening pigs reared outdoors since weaning in Great Britain (GB) (non-controlled housing conditions) was implemented, and the risk of microbial contamination of carcasses may be reduced. However, despite this change, these risks would be expected to be no greater than those that are expected if visual-only inspection were to be implemented for fattening pigs from controlled housing conditions.

Acknowledgements

This Project FS145003 was funded by the Food Standards Agency (FSA). The complete final report can be found at http://www.foodbase.org.uk/results.php?f_report_id=797. We thank all the participants in the within-abattoir field trial - the study premise owners, the plant staff and the official inspection team; colleagues including Prof George J. Gunn (SRUC), Derek Armstrong (British Pig Executive, BPEX), SAC Consulting Veterinary Services staff at Inverness; Manuel Sanchez Vazquez (formerly of SAC); Dr Roger Humphry (SRUC), BioSS (Biomathematics and Statistics Scotland).

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