



FSA Project MO1038:

Reduction of salmonella contamination of pig meat

Duration

1st July 2005 - 31st July 2007

Project Partners:

Food Refrigeration and Process Engineering Research Centre (FRPERC), University of Bristol

Division of Food Animal Science (DFAS), University of Bristol

Background

The UK Food Standards Agency (FSA) has a target to reduce salmonella in pigs by 50% by 2010. Studies indicate that cross contamination of carcasses with salmonella occurs during the slaughtering process. This project aims to provide a benchmark, not only on current practice, but also on the effects of any simple modifications to current practice that could reduce salmonella or other contamination. The key objectives of this study are:

1. Quantify the current scientific and technical state of the art on alternative/novel pig slaughtering and processing procedures and pork decontamination.
2. Investigate alternative approach(es) to produce a clean hairless carcass and ultimately packaged pork.
3. Quantify the effects of the alternative approach(es) on contamination.
4. Determine if the incorporation of decontamination stages, physical and/or chemical, either pre or post evisceration, within the alternative systems can significantly reduce salmonella contamination.
5. Investigate the introduction of the best novel intervention steps in commercial practice in both existing and new build slaughterhouses.

Research Summary

- Site surveys of eight UK pork abattoirs have been made (in collaboration with FSA project MO1040) to gain baseline data and determine the range of equipment and process parameters in use. A 'typical' industrial pork production process has been defined.
- A comprehensive review of published literature on the effect of different processing steps on microbial contamination has been completed.
- A review of alternative processing techniques and a review of potential technology transfers from other processing sectors have been produced.

- The results from both the survey and reviews were analysed to identify (a) processes that are the main source of salmonella contamination, and (b) areas where further work is required to clarify the situation. This has been used to focus the project research activities.
- The dehairing process was identified as one of the main potential sources of cross-contamination.
- Bench scale experiments have examined dehairing forces and hair extraction effort required on trotters for a range of hot water immersion, and hot-moist air time/temperature scalding treatments. Scalding with atmospheric steam has also been investigated. Results showed that immersion scalding for more than 4 mins at 65°C gives no additional benefits in hair removal. Hot-moist air scalding gave highly variable results. Steam scalding was difficult to control.
- An alternative dehairing method using an intense scald spray (2 mins at 70°C) followed by application of pressure jet has been proposed and practically evaluated using trotters. Initial results showed an equivalent effect to current dehairing methods and reductions in TVC counts of c.3 log.
- Baseline data have been collected in the Langford research abattoir on Enterobacteriaceae changes (as an indicator for Salmonella) at specific carcass locations through the scald and dehair process. Carcass locations were sponge swab sampled and included anus, ham, back, belly, belly flaps, jowl, foreleg and mouth. All locations except the mouth showed mean reductions in bacterial levels between c.1 log (belly flap) and c.3.5 log (ham). The mouth exhibited a c.3 log increase. Swabbing of equipment confirmed bacterial build up with increases of c.1 log on the gambrelling table and c.1.25 to c.4 log in the dehairing machine.
- The literature and baseline trials above suggested leakage from anus and oesophagus were potential salmonella contamination sources. Anal bunging and oesophagus clipping have been investigated. Anus, ham, jowl, (pre-wetted sponge) and mouth (wet/dry swab) locations on the carcass examined for Enterobacteriaceae (Salmonella indicator) before scalding and after dehairing, with and without anal bungs and oesophagus clips. Several iterations of bung designs were necessary to ensure bung security throughout the scald and dehair process. Oesophagus clipping showed no benefit. Enterobacteriaceae levels at the anus showed a c.3.25 log reduction for bunged carcasses, and a c.3.75 log increase for unbunged carcasses.
- The effects of hot pre-scald wash (61°C, 30s), cold pre-scald wash (15°C, 30s), and intense scald (70°C, 2m [conditions giving lowest hair removal forces in previous work]) on scald tank water quality have been evaluated. Industrial survey mean scald conditions (61°C, 5m7s) were used as control. Scald water turbidity, conductivity, redox, free chlorine, total chlorine, and post process particulates in the scald tank were measured for processing of 5 successive trotters from Langford abattoir. Few differences were seen in conductivity, free chlorine, and total chlorine measurements between current, intense scald, and pre washing processes. Hot or cold pre scald washes decreased, while intense scalding increased, the rates of turbidity rise and amount of post process particulates.
- Following these bench scale evaluations a hot pre-scald wash has been evaluated in the Langford research abattoir. Carcasses were subjected to 30s of washing from a purpose built automated rotating spray bar system comprising 12 full cone nozzles. Carcass surface temperatures reached c.70°C. Sponge swabs for Enterobacteriaceae were taken at anus, ham and foreleg before pre-scald wash and after dehairing. Results were skewed by a few large values and the washing effect in the scald tank may be obscuring measurements, but pre scald washing showed little obvious microbiological effect in these results. However, carcasses were visibly cleaner upon entry to scald tank. Turbidity results showed no clear effect of pre scald washing.

The research is continuing to evaluate anal plugging in industry, confirm pre-scald wash results and further investigate hot pressure spray dehairing.

Some Publications from this Project

Sources of salmonella contamination in pig processing

James, S., Purnell, G., Wilkin, C.-A., Howell, M. & James, C. (2007) 7th International Symposium on the epidemiology & control of foodborne pathogens in pork (SAFEPOK 2007), Verona, Italy, 9-11 May 2007. [FRPERC Biblio Ref: 884]

This poster presented results from the industrial survey and reviews of published literature and technology from other sectors. The main consensus of industrial opinion gleaned from the plant visits suggested was that contamination comes from the live animals and the main cross-contamination issues in the abattoir are in the lairage, some scald tanks and polishers. The main cross-contamination issues in the evisceration line are considered to be in handling and inadvertent gut rupture. In the published data there was general agreement that the main source of bacterial contamination on a meat carcass is from the animals themselves. There are comments in the literature that 70% of carcasses contaminated with salmonella are derived from carrier pigs and the remaining 30% are from cross-contamination from other sources. The main sources of cross-contamination are the skin and hooves of the animal; faeces voided by the animals; bacteria derived from the opened gut; and soil, dust, etc., carried to the killing-floor. Some researchers, however, believe that a degree of the initial contamination may be airborne. There is conflicting evidence as to the role and importance of different processing steps.

Further information can be found in the accompanying paper .

Changes in microbial distribution and water conditions during the scalding and dehairing of pig carcasses

Wilkin, C.-A., Purnell, G., James, S., Howell, M. & James, C. (2007) 7th International Symposium on the epidemiology & control of foodborne pathogens in pork (SAFEPOK 2007), Verona, Italy, 9-11 May 2007. (Presentation) [FRPERC Biblio Ref: 887]

This lecture presented the survey of current processing conditions in UK pig slaughterhouses and a review of published data identified pork scalding and dehairing systems as a likely major source of salmonella contamination during pork processing. Work was therefore carried out to evaluate the factors that may have an influence on the levels of Salmonella spp. on the surface of pigs during the scalding and dehairing process. The scald tank temperature, scalding time and changes in the condition of the scald tank water were analysed during the processing of two batches of pigs in a small EU licensed abattoir. In each trial the levels of Enterobacteriaceae (indicative of faecal and hence possible Salmonella contamination) at 8 different sites on three carcasses, both before and after the scalding and dehairing process, were determined.

Further information can be found in the accompanying paper .

Other Publications

Microbial studies of carcass hygiene issues.

Purnell, G., James, S., Wilkin, C.-A., Fisher, A., Corry, J., Howell, M., Brown, T. & James, C. 2007. in Proceedings; 2007 CIGR International Symposium on Food and Agricultural Products: Processing and Innovations. Naples, Italy. 24-26 September. [FRPERC Biblio Ref: 921]

Assessment of processes and operating conditions in UK pork abattoirs

Tinker, D. B., Dodd, C. E. R., Richards, P., James, S. J., James, C., Wilkin, C.-A., Burfoot, D., Howell, M., Purnell, G. (2007) . 7th International Symposium on the epidemiology & control of foodborne pathogens in pork (SAFEPOK 2007), Verona, Italy, 9-11 May 2007. [FRPERC Biblio Ref: 886]

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