The development of a tool to measure how well pathogens are controlled in a pork slaughterhouse

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Food Standards Agency UK

Workshop on salmonella control in pigs
February 26th 2009
Can process data in slaughterhouses be linked to food safety and used as a measure of control?

- Initial industry interviews
- Checklist design
- Second round of industry interviews
  - Information that is/ could held in plants
- Review of red/white meat literature
  - Identification of processing potential hazards
  - Decisions on what information relates to what hazard
- MO1044 (Rapid methods for carcass/plant environment)
- MO1038 (Redn Salmonella in pigs)
- MO1039 (Redn of Campylobacter in poultry plants)
- MO1037 (Redn of airborne contamination in poultry plants)
- Best practices with evidence
- Application of statistical process controls for objective data
  - Ways of objectively monitoring adherence to best practices
Basic approach for each species

- Split the production processes into distinct stages
- Review scientific literature and our current research project outputs relating to each stage
- Draw up best practices/proven hazards based on science (Campylobacter, Salmonella, E.coli)
- Using the opinion of experts
  - Relatively rank each process stage
  - Weight each stage based on the rankings
Practices within stages

• Within a stage the range of practices or measurable performance are allocated a score from a response to a question
• Questions phrased in a manner that requires record keeping and thus it is an objective assessment that can identify areas for improvement
• The additive score from a stage is multiplied by the stage weighting
Status of the project

• Prototype tools have been developed for pigs and broilers linked to UK strategic targets to reduce salmonella in pigs and campylobacter in chickens.

• Partnership trials with processors are in progress
Process monitoring (Lairage) (stage multiplier = 4)
(click to see the scientific background and explanatory text for each question in this section)

653. How long are stock typically held in lairage?
- 100% held for more than 2 hours (1, 2, 4, 8, 10, 12, 15)

654. Are pigs held on a clean (i.e. wet removal of gross detritus) and sanitised (i.e. treated with a chemical decontaminant) at an appropriate stocking density to prevent welfare issues (e.g. overheating or stress) transporter instead of in the plant lairage?
- No, this never happens (1, 2, 3, 4, 5, 6)

655. What is the lairage floor surface composed of?
- Mostly solid concrete (1, 10, 10)

656. Is the lairage generally cleaned (i.e. wet removal of gross detritus) in between batches of animals?
- No, this never happens (1, 5, 10, 15, 20, 25)

657. Is the lairage cleaned and sanitised (i.e. treated with a chemical decontaminant) in between batches of animals?
- No, this never happens (1, 20, 40, 60, 80, 100)

658. Is any sanitation a 'validated as effective' procedure?
- No (3, 10, 1)

659. Are the waters changed and the water troughs cleaned between batches of animals or, alternatively, does the plant use clean water drinkers that have been proven to prevent cross contamination between different animals?
- No, this never happens (1, 2, 4, 8, 10)

660. Are the animals power-washed on exit from the lairage? (we are currently awaiting additional data that may show a advantage for low pressure washing by, for example, spraying)
- No, this never happens (1, 2, 4, 8, 10)

Module Summary
Maximum available value
- Module total: 186
- Module mean: 23.25
- Module overall score: 93
Process monitoring (Stunning) (stage multiplier = 1)
(click to see the scientific background and explanatory text for each question in this section)

031 How is backup stunning undertaken?
- Using a bolt all of the time
  - (1, 2, 4, 6, 8, 10, 15)

032 Is the roll out surface cleaned (i.e. wet removal of gross detritus) in between carcasses?
- Not cleaned during a day’s kill
  - (1, 2, 4, 6, 8, 10, 15)

033 Is the roll out surface cleaned and sanitised (i.e. treated with a chemical decontaminant) in between carcasses?
- Not sanitised during a day’s kill
  - (1, 20, 40, 60, 80, 100, 150)

034 Is any sanitation a 'validated as effective' procedure?
- No
  - (3, 10, 1)

035 Is the roll out surface solid floor or a grate?
- A solid floor
  - (1, 40)

Module Summary
Maximum available value
Module total: 230
Module mean: 46
Module overall score: 46

Part save this assessment for later

Process monitoring (Exsanguinations) (stage multiplier = 1)
(click to see the scientific background and explanatory text for each question in this section)
Process monitoring (Singe and polish) (stage multiplier = 6)
(click to see the scientific background and explanatory text for each question in this section)

Q054 Is polishing undertaken?
Yes, all of the time
(1, 2, 4, 6, 8, 12)

Q055 If so are polishing equipment cleaned (i.e. wet removal of gross detritus) during each processing day?
Typically not cleaned during the day’s kill
(1, 2, 4, 6, 8, 10, 12)

Q056 If so are polishing equipment cleaned and sanitised (i.e. treated with a chemical decontaminant) during each processing day?
Typically not sanitised during the day’s kill
(1, 1, 8, 12, 16, 20, 24, 30)

Q057 Is any sanitation a ‘validated as effective’ procedure?
No
(3, 16, 1)

Q058 Is the automatic singeing stage duplicated (i.e. repeated) after initial polishing?
No
(1, 1, 100)

Q059 Is an additional hand singeing stage undertaken?
No, this never happens
(1, 2, 4, 6, 8, 12)

Q060 Are there areas of the carcass that stay below 50°C during singeing?
Yes, all of the time
(3, 1, 5, 20, 50, 75, 120)

Module Summary

<table>
<thead>
<tr>
<th>Module total</th>
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<tbody>
<tr>
<td>291</td>
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<td>41.57</td>
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<tr>
<td>249.43</td>
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Singeing and polishing

Information that relates to specific question(s) is highlighted with the appropriate question number in pink.

Effective singeing can result in almost complete removal of skin-surface contamination (Berends et al., 1997). However, not all singeing is completely effective and consequently, the polishing stage that routinely occurs after singeing has been estimated to be directly responsible for between 5% and 15% of all carcass cross-contamination on pork lines (Berends et al., 1997). Polishing can redistribute those few bacteria that survive the flame treatment across the surface of the carcass (Berends et al., 1997). After a typical singe, under routine processing conditions, carcass APC were reported to decrease by 3 log units cm⁻² (Bolton et al., 2002). The finding was confirmed when similar reductions were reported by Pearce et al., (2004). In addition to APC, Pearce and colleagues expanded the bacteriology to observe significant reductions in numbers of total coliforms. *S. enterica* were not detected after singeing by Bolton et al. (2002). The high level of decontamination reported was attributed to the use of a hand-held singeing unit which can be more comprehensively and consistently applied to all areas of the carcass compared to automated singeing machines used in larger plants (Bolton, 2002). However, although Bolton and colleagues accept that it is difficult to extrapolate their findings when scaling up to routine processing in full throughput plants, no *Salmonella* were detected also after singeing in full throughput plants operating under commercial processing conditions by Pearce et al. (2004).

Within a high throughput plant Warriner et al. (2002) found that the levels of total viable bacteria after both singeing and polishing were not significantly different. It is unclear if the difference was due to imperfect singeing or the inclusion of the polishing step that was not included within the small plant studied by Bolton et al. (2002). The levels of *E. coli*, as an indicator of enteric contamination, had reduced by one log unit when compared to the numbers after singeing and de-hairing. However, substantial numbers of *Enterobacteriaceae* and *E. coli* were found on both the dry and wet polisher. In the case of the wet polisher no contamination was found at the start of operations but after 4 hours numbers significant increased to more than 5 logs *Enterobacteriaceae* and 4 logs for *E. coli*.

The polishing stage of processing was the focus of a study by Pearce and co-workers (2004). They report that residual hair removal by polishing led to a one-log increase in APC, coliforms and resuscitated coliforms. The stage however...
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<tr>
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An example of a uniformly-singed carcass as evidenced by the even distribution of colour.
A poorly-singed carcass from a UK plant. The bluish distribution of colour on the trotters reveals an area that has not been heated enough to cause bacteria known to be ineffectively heated in some singers include the rectum and scrotum of carcasses.

A list of contractors that can undertake carcass temperature profiling is available by clicking here. The Food Standards Agency does not endorse any of the costs listed. Other methods (e.g. infra red probes) can also be used to profile the temperatures across pig carcasses.
**Infra red-based temperature profiling of singed pig carcasses**

Below is a list of contractors that can undertake infra red (IR)-based temperature profiling of pig carcasses by a photography-based method. Please contact [dawn.harrison@bristol.ac.uk](mailto:dawn.harrison@bristol.ac.uk) with your details if you would like to be added to the list.

Please note that these contractors are in no way endorsed by the Food Standards Agency. The information provided here is only to help simplify the sourcing for the UK pig industry. There are alternative methods for the profiling of carcass temperatures that can also be used.

<table>
<thead>
<tr>
<th>Company</th>
<th>Hutchison Scientific Ltd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact person</td>
<td>Mike Hutchison</td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:mh@hutchisonscientific.com">mh@hutchisonscientific.com</a></td>
</tr>
<tr>
<td>Phone</td>
<td>01902 399970</td>
</tr>
<tr>
<td>Website</td>
<td><a href="http://www.hutchisonscientific.com">www.hutchisonscientific.com</a></td>
</tr>
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Each plant visit will result in the generation of around 50 carcass pictures taken across the entire processing day and, wherever possible, over a range of carcass sizes. The camera used takes high-resolution simultaneous IR and visible-light pictures all of which are provided on CD to the plant as part of the reporting process. A short report on the effectiveness of singeing, which includes prints of the best case, worst case, and typically-singed carcasses is provided within a few days of the plant visit.

<table>
<thead>
<tr>
<th>Company</th>
<th>Dave Tinker and Associates Ltd</th>
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<tbody>
<tr>
<td>Contact person</td>
<td>Dave Tinker</td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:d.tinker@ntlworld.com">d.tinker@ntlworld.com</a></td>
</tr>
<tr>
<td>Phone</td>
<td>01525 750337</td>
</tr>
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</table>
Are there any carcasses touching other carcasses in the chiller?  
Yes  (1, 10)

Are staff permitted to enter chillers after they are filled and running?  
All of the time  (1, 2, 5, 10)

Are the temperature profiles as expected and predicted to prevent the growth of E. coli? (RI-based assessment)  
None of the time  (1, 20, 50, 100)

Module Summary  Maximum available value  
Module total:  259.5  
Module mean:  38.5  
Module overall score:  192.5  

Part save this assessment for later

Plant-related information (General) (stage multiplier = 2)

Is the slaughterhouse subject to unannounced third party audit (e.g. from retailers)?  
No  (1, 40)

Does the plant have a mechanism to feed back down the line problems such as increased visible contamination that become apparent at the end of processing?  
No  (1, 50)

Module Summary  Maximum available value  
Module total:  90  
Module mean:  45  
Module overall score:  90  

Part save this assessment for later

Submit Demo Assessment  Back to main menu
A measure of hazard control

• General theme of reward the “good” don’t punish the “bad”

• Risk-based approach; similar to HACCP but has a strict science base for hazards and scorings and is not just reliant on the opinions of people

• Inherent flexibility – if plants can prove new good practices; they can have additional questions and appropriate scorings
Trialling the new method

• To help refine the tool plant trials are underway
  – A working group has been established with the British Meat Processors Association /Zoonosis National Control Programme for interested pig processors
  – Following training sessions plants have completed the questionnaire and provided feedback to help refine the prototype
  – Assistance and support is available
  – A second trial currently in progress
Improvement projects

• Following assessment with the tool small projects can be supported
• to help plants measure key data
  – Singeing temperatures
• to try interventions
  – bunging
• to measure the effect of interventions
  – microbiology
  – temperature
Ongoing development of the assessment tools

- Scientific information for pigs being updated
  - needs to be periodically undertaken
- Output from a complimentary study looking at barriers to implementation incorporated
  - once proven system could be used to decide audit frequency
Refined tool to be available March 09.

- Plants will be able to identify areas for improvement based on evidence
- How can we prove that the tool works?
  - implementing change and improving scores over the next few years will result in a reduction in SALMONELLA levels on pig carcasses.
- Use EFSA baseline survey and FBO ongoing monitoring
- Repeat in 2010
THANK YOU FOR YOUR ATTENTION