Control of Salmonella at pig finishing farms with a farm decision tree

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Summary: To decrease the prevalence of Salmonella in the Dutch pork chain a management tool is developed based on the HACCP methodology (Hazard Analysis of Critical Control Points) and tested at three pig farms on effectiveness and practical feasibility. A so called HACCP team defined Critical Control Points (CCP) and general measures. For all identified CCP's corrective actions are determined. Based on the obtained knowledge eight decision trees are designed and applied at three pig farms during eight months. The finishing pigs were tested bacteriologically and serologically every 2-3 month on Salmonella typhimurium. At one farm the number of positive samples declined over time. The other two farms showed a low prevalence during the entire trial period, even though all farms had a high prevalence in August 2001. It can be concluded that the decision trees are useful to determine weak points and to advice specific control measures to prevent or reduce Salmonella in pig farms.

Keywords: Hazards; HACCP methodology; weak points; farm specific measures.

Introduction: The Dutch Product Boards for Livestock and Meat is designing a Salmonella Control Program to reduce the number of cases of human salmonellosis. The focus of the program is on slaughterhouses and pig farms. The Product Boards asked the Applied Research of the Animal Sciences Group to develop and test a management tool to reduce the Salmonella prevalence at finishing farms.

Materials and Methods: To develop and test the tool, three steps were necessary: 1) identification of hazards, measures and corrective actions by means of the HACCP methodology. 2) Design of the tool and 3) Testing the tool by application at three pig farms.

Step 1) Hazards are identified by means of the HACCP methodology (FAO/WHO Codex Alimentarius Commission, 1993). However, four adjustments to the HACCP methodology were necessary: 1) instead of eradication of the hazard (demand of HACCP), reducing the hazard was accepted 2) the seriousness of the hazard was defined as the number of pigs at the farm that might become infected due to the hazard (instead of the seriousness of the hazard of the end product for humans) 3) A Critical Control Point (CCP) in this research did not have to meet the demand that the hazard in a later step of the process must not be eliminated and 4) in the hazard identification a distinction was made between the introduction and spread of Salmonella at pig farms. A HACCP team consisting of Salmonella experts and a farmer carried out the risk analysis for the introduction and spread of Salmonella at pig finishing farms. For each step in the process of pig production, hazards are identified.

Step 2) With the results of step 1, a management tool had to be designed that is user-friendly, effective, simple, cover all farm processes and completing it should not take too much time. The aim was a tool that determines at each kind of farm the specific control measures that can reduce the introduction and spread of Salmonella. Step 2 resulted in the development of eight decision trees with all hazards and control measures.

Step 3) The effectiveness and the practical feasibility of the decision trees were determined by applying a number of the specific control measures during eight months at three pig farms with
finishing pigs. It was known that these farms had a high Salmonella prevalence in August 2001. The finishing pigs were tested bacteriologically and serologically on Salmonella typhimurium every 2-3 months from May 2002 until December 2002. The faecal samples were tested qualitatively. The blood samples were tested with a mixed ELISA (positive when OD>10%). To get more insight in the opinion of the farmers, the farmers completed at the end of the trial period an evaluation form.

**Results:** Step 1) Three hazards were identified as CCP and 34 hazards were identified as a 'point of attention' (a point of attention is a hazard that can be reduced by implementing general control measures). The three CCP's, their limits, methods and frequencies of monitoring and their corrective actions are shown in table 1.

**Table 1. Critical control points, their limits, methods and frequencies of monitoring and their corrective actions to prevent the introduction and spread of Salmonella at pig finishing farms**

<table>
<thead>
<tr>
<th>CCP</th>
<th>Limits and tolerances</th>
<th>Method of monitoring</th>
<th>Frequency of monitoring</th>
<th>Corrective actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water from well</td>
<td>standards of the Animal Health Service**</td>
<td>Sampling according procedures of the Animal Health Service**</td>
<td>Twice a year</td>
<td>1) according to advice of Animal Health Services or Veterinarian</td>
</tr>
<tr>
<td>Liquid by products</td>
<td>pH &lt; 4</td>
<td>Test pH at production level and at animal level</td>
<td>Every feeding</td>
<td>Adding acids</td>
</tr>
<tr>
<td>Piglets*</td>
<td>Salmonella negative piglets (bacteriologically tested)</td>
<td>Declared Salmonella free</td>
<td>Before every purchase of piglets</td>
<td>No purchase</td>
</tr>
</tbody>
</table>

*This CCP can not be put into practice yet

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Step 2) To fulfill the requirements eight decision trees were designed covering all farm processes: 'supply of piglets', 'use of drinking water', 'use of pelleted feed', 'use of cereals', 'use of roughage', 'use of liquid by products', 'hygiene management' and 'daily management'. After completing the decision trees, the farm specific control measures that should be implemented to reduce introduction and spread of Salmonella are determined.

Step 3) At the first sampling period, only one farm had multiple positive samples. At this farm the number of positive samples declined over time. At the other two farms a very limited number of positive samples were found during the entire trial period.

Although the amount of time necessary to complete the decision trees was long (1-2 hours), the pig farmers indicated that the decision trees are user-friendly, complete and recommendable to other pig farmers.

**Discussion, conclusions and recommendations:** The results of the farm with a high prevalence at the start of the trial period seems promising. However, it is not possible to determine the effectiveness...
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of the advised control measures on the Salmonella prevalence at the farm based on this research due to the limited number of farms. The adjusted HACCP methodology is useful to determine weak points and the control measures in a structured way for, in this case, reducing the risk of introduction and spread of Salmonella at a pig finishing farm. The decision trees are a useful tool to specify the farm specific hazards and control measures. The maximum benefit of the decision trees will probably be achieved when the decision trees are completed together with an advisor.

References:

MIXED CULTURE OF COMMENSAL BACTERIA REDUCES E. COLI IN NURSERY PIGS

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Summary: The purpose of the present study was to use field trials to evaluate the efficacy of a porcine-derived, defined culture (RPCF) of commensal bacteria for prevention of clinical disease from enterotoxigenic strains of Escherichia coli in weaned pigs. Neonates (< 24 h old) were orally administered RPCF and were monitored throughout the post-weaning nursery period on five geographically separated farms. The farms had a history of high mortality from F-18 strains of E. coli. RPCF-treated pigs had reduced mortality, morbidity, and medication costs from E. coli compared to untreated pigs. Although experimental, RPCF may become an effective control procedure for enterotoxigenic E. coli.

Keywords: enterotoxigenic, mortality, field trials, RPCF, medication costs

Introduction: Escherichia coli has been described as the major cause of neonatal and weaned pig diarrhea and death in pigs (Bertschinger et al., 1992). Mortality and loss of productivity from edema disease cost the U.S. swine industry millions of dollars annually. The treatment of choice for an outbreak of enterotoxigenic E. coli has been antibiotics; however, due to antibiotic resistance, new control methods need to be explored. There appears to be global interest in the use of probiotics and competitive exclusion cultures as alternatives to antibiotics. The theory of competitive exclusion cultures works on the premise that when an animal is born, the intestinal tract is a sterile environment with none of the microflora found in healthy adults of that species. The absence of the normal microflora in the neonate predisposes it for colonization by enteropathogens. If adult microflora is administered to neonates, the gut will be colonized by commensal bacteria earlier than what would occur naturally and the neonate will be more resistant to colonization by enteropathogens (Nurmi and Rantala, 1973; Lloyd et al., 1977). Some mechanisms by which commensal bacteria block colonization by pathogens include competition for nutrients, occupation of receptor and attachment sites, and production of bactericidal compounds. Our laboratory developed a defined, porcine-derived, mixed culture of commensal bacteria designated RPCF. In vitro, RPCF has prevented colonization by Salmonella and E. coli (Harvey et al., 2002). In laboratory challenge studies with enterotoxigenic E. coli, RPCF-treated pigs had reduced mortality, decreased shedding, and decreased gut concentrations of E. coli compared to controls (Genovese et al., 2000, 2001). The objective of the