SUBCLINICAL SALMONELLA INFECTION IN DANISH FINISHING PIG HERDS:
RISK FACTORS

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An important part of the salmonella surveillance programme in Danish slaughter pig herds (Mousing et al. 1997) is to reduce the occurrence of salmonella in herds with a moderate to high proportion of subclinically infected pigs. This includes advisory visits in infected herds where veterinarians and consultants inspect the herd and define changes in management in order to reduce the infection level. A good understanding of the relationship between risk factors and occurrence of salmonella is essential to control infection and to avoid spread of salmonella among and within herds. In study 1, management and factors related to feeding in randomly selected herds and herds with a high sero-prevalence were compared in order to determine factors that could affect the risk of salmonella infection. Study 2 was an epidemiological analysis of the association between serological results and management factors in herds selected from two slaughterhouse-cooperations.

MATERIALS AND METHODS

Study 1 comprised 96 randomly selected herds and 39 herds selected among herds with a high sero-prevalence in the salmonella surveillance programme in Danish slaughter pig herds. Herd visits were performed in the period March 1995 to December 1996. From each herd, 10 pens were examined by 5 blood samples forwarded to the Danish Veterinary Laboratory and examined in the mix-ELISA (Nielsen et al. 1995). The results of the serological testing were stated as OD% (optical density).

The blood samples were examined to confirm that the 96 randomly selected herds had a low sero-prevalence and that the 39 high sero-prevalence herds were still high prevalence herds. When the herds were visited, a questionnaire was filled in to gather information about cleaning procedures, bio-security procedures (pigs, tools, persons) and feeding procedures. Data were entered in a database and checked by, e.g. comparing questions on same topics to assure agreement between answers and thereby obtaining the best data quality possible. \(\chi^2\) or 2-tail Fishers Exact test were applied to screen for the association between the risk factors from the questionnaire and antibodies against *Salmonella enterica* (low vs. high sero-prevalence) in order to select the factors that should be included in further statistical modelling. The screening of risk factors is presented here.

Study 2: In the period from October 1 to December 31 1995, two major Danish slaughterhouse-cooperatives sent out questionnaires to all their pig suppliers. Serological results on these herds were extracted from the Danish Zoonosis Register, covering the same period as

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the questionnaires were collected (October 1 1995 to December 31 1995). A subset of 1850 herds, from which consistent answers to all questions were obtained, was created. Serological examination of meat juice for specific antibodies to Salmonella enterica was performed by means of a similar, but modified mix-ELISA (Mousing et al. 1997). Samples with an OD% over 40 were considered positive in this study. Between 3 and 105 samples per herd were obtained.

A logistic regression analysis was performed (SAS, 1996). Unit of observation and analysis was the individual sample/pig (Dahl 1997).

RESULTS

Study 1: The results from the testing of blood samples confirmed that the 96 randomly selected herds had a low sero-prevalence, and the 39 high sero-prevalence herds still had a high sero-prevalence at the time of the visit.

A total of 44 risk factors were screened by 2×2 tables. The factors related to feeding had a strong association (OR between 5.6 - 7.4) with the salmonella occurrence. Some management factors were also associated with the salmonella occurrence (table 1). Among non-significant factors were type of flooring, use of straw, finisher or farrow-to-finisher operation, quarantine facilities, delivery room, and hygienic lock facilities.

Table 1. Preliminary screening of risk factors by 2×2 tables (χ² or 2-tail Fishers Exact). Ninety-six low sero-prevalence herds were compared to 39 high sero-prevalence herds. Only the statistically significant feed related factors and factors related to cleaning are presented here.

<table>
<thead>
<tr>
<th>Factor</th>
<th>OR</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry feed</td>
<td>7.3</td>
<td>0.040</td>
</tr>
<tr>
<td>Purchased feed</td>
<td>7.4</td>
<td>0.001</td>
</tr>
<tr>
<td>Pelleted feed</td>
<td>5.6</td>
<td>0.001</td>
</tr>
<tr>
<td>Manurefree cleaning between batches</td>
<td>4.2</td>
<td>0.001</td>
</tr>
<tr>
<td>Disinfection between batches</td>
<td>4.8</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Study 2: Table 2 shows OR for factors found to be significantly associated with sero-positivity on the pig level. No significant associations between sero-positivity and the following factors were found: Type of flooring, use of straw, access to outdoor-area, finisher or farrow-to-finisher operation, pen-area per pig before delivery.

SUMMARY

This presentation includes the results of two epidemiological studies of risk factors for occurrence of antibodies against *Salmonella enterica* in Danish pig herds. In study 1, management and factors related to feeding in randomly selected herds and herds with a high sero-prevalence were compared in order to determine factors that could affect the risk of salmonella infection. Study 2 was an epidemiological analysis of the association between serological results and management factors. The conclusions were: 1) Feed related factors (dry/wet, purchased/home mixed, and pelleted/non-pelleted feed) were associated with the occurrence of *Salmonella enterica* in Danish pig herds. 2) Other management factors may be important for the occurrence of antibodies against *Salmonella enterica* in Danish pig herds. 3) Investigation of risk factors for occurrence of antibodies against *Salmonella enterica* in pig herds should include information on feeding systems otherwise, confounding is likely to be present and may lead to wrong conclusions.