SUBCLINICAL SALMONELLA INFECTION IN DANISH FINISHING PIG HERDS:
PREVALENCE OF S. ENTERICA MEASURED BY BACTERIOLOGICAL AND
SEROLOGICAL EXAMINATION

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Subclinically salmonella infected herds may represent a contamination risk for pork products although no clinical signs are present. In the nation-wide Salmonella enterica surveillance and control programme in Danish slaughter pig herds (Mousing et al. 1997) the salmonella prevalence in Danish pig herds is being monitored. The monitoring is based on serological examination of meat juice (Nielsen et al. 1997). Serological examination of blood samples and bacteriological examination of pen samples is used as follow-up.

The occurrence of salmonella in purchased feed, produced at Danish feed mills, is monitored by ongoing bacteriological examinations of feed samples after heat treatment (Annual Report on Zoonoses in Denmark 1996). However, the feed may be contaminated during transport, storage or in the feeding systems at the farms. Except for the purchased concentrate added, home-mixed feed is not being monitored. Therefore, the actual occurrence of salmonella in the feed when fed to the pigs is unknown.

The aim of the present study was to determine the prevalence of S. enterica in pen and feed samples and to estimate the sero-prevalence based on examination of blood samples.

MATERIALS AND METHODS

The study comprised 96 finishing herds randomly selected among herds that were using the Integrated Farm Management System and had been delivering pigs for slaughter to 6 abattoirs geographically representing Denmark. In each herd 10 pens were examined by: (1) a pooled pen sample (5x5 g faeces), (2) a feed sample (50 g feed) and (3) 5 blood samples. The pens were selected to represent the oldest finishing pigs and all buildings with growers or finishers. The samples were forwarded to the Danish Veterinary Laboratory (DVL) and were examined by bacteriological culturing or in the mix-ELISA (Nielsen et al. 1995). The bacteriological results were stated as salmonella serotype or negative, and the serological results were stated as OD\% (optical density\%).

Salmonella serotypes were categorized as either 'S. Typhimurium' or 'non-S. Typhimurium'. A herd was defined as bacteriologically positive if S. enterica was isolated from at least one sample, and the prevalence of positive samples was calculated for both categories of serotypes.

To ensure a high sensitivity of the serological test, a pig was defined sero-positive if OD\% > 10 (Nielsen et al. 1995). When estimating the herd sero-prevalence different within herd, prevalences of positive pigs were applied for defining a sero-positive herd (Table 1).

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RESULTS

Prevalence of bacteriological positive samples: S. Typhimurium was isolated from pen samples from 14 herds (herd prevalence = 14.6%). In these herds, the proportion of positive pens ranged from 0.1 to 0.5 with mean = 0.27 and mode = 0.2. Non-S. Typhimurium was isolated from pen samples from 8 herds (herd prevalence = 8.3%) in which the proportion of positive pens ranged from 0.1 to 1.0 with mean = 0.25 and mode = 0.1. From 2 herds, both S. Typhimurium and non-S. Typhimurium were isolated.

S. Typhimurium was isolated from 1 feed sample. Non-S. Typhimurium was isolated from feed samples from 25 herds (herd prevalence = 26%). The proportion of positive feed samples ranged from 0.1 to 1.0 with mean = 0.35 and mode = 0.1.

Sero-prevalence: Table 1 shows the distribution of herds based on different within-herd sero-prevalences. Sero-positive pigs were found in 57 herds (59.4%), and 18 herds (18.8%) had a within herd sero-prevalence above 0.2.

The distribution of within herd prevalences of salmonella in feed, pen and blood samples are shown in figure 1.

![Graph showing distribution of within herd prevalences of salmonella in feed, pen and blood samples.](image)

Figure 1. Distribution of categories of within herd prevalences of salmonella in feed, pen and blood samples

(OD% > 10) in 96 Danish finishing herds.

Table 1. The occurrence of antibodies against S. enterica in 4871 pigs from 96 Danish finishing herds. Distribution of herds in categories of within herd prevalences of positive blood samples (OD% > 10).

<table>
<thead>
<tr>
<th>Within herd sero-prevalence</th>
<th>Number of herds</th>
<th>Per-cent herds</th>
<th>Cum. per-cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>39</td>
<td>40.6</td>
<td>100.0</td>
</tr>
<tr>
<td>[0, 0.04]</td>
<td>14</td>
<td>14.6</td>
<td>59.4</td>
</tr>
<tr>
<td>[0.04, 0.2]</td>
<td>25</td>
<td>26.0</td>
<td>44.8</td>
</tr>
<tr>
<td>[0.2, 0.4]</td>
<td>12</td>
<td>12.5</td>
<td>18.8</td>
</tr>
<tr>
<td>[0.4, 0.5]</td>
<td>4</td>
<td>4.2</td>
<td>6.3</td>
</tr>
<tr>
<td>[0.5, 1]</td>
<td>2</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Total</td>
<td>96</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION

The bacteriological and serological prevalence determined in this study was based on a random sample of herds using the Integrated Farm Management System. The bacteriological prevalence of salmonella in feed was high compared to the prevalence < 0.1% reported from the national surveillance of feed (Annual Report on Zoonoses in Denmark, 1996). An explanation for this difference could be that the sample site in this study was at the cribs, hence included a number of possible ways the feed could have been contaminated after leaving the feed mills. Furthermore, both home-mixed and purchased feed was examined. In order to investigate the source(s) of contamination, further studies of single feed components, transport and storage are needed. The solitary isolate of S. Typhimurium from one feed sample is likely to be due to faecal contamination, since S. Typhimurium was isolated from pen samples from the same herd, and since the feeding system was purchased, dry, pelleted, ad libitum feeding, which does not allow sampling of feed without contamination.

The distribution of herds at different within herd sero-prevalence categories cannot be directly compared with the results of the nation-wide Salmonella enterica surveillance and control programme in Danish slaughter pig herds, because the programme uses meat juice instead of serum and defines pigs as sero-positive if OD% > 40. However the present study supports the findings that herds with high salmonella prevalence are rare, since only 2.1% had more than 50% sero-positive pigs at OD% > 10.

REFERENCES


SUMMARY

As part of the ongoing national salmonella surveillance programme, Danish pig herds and feed mills are being monitored. The salmonella prevalence in pig herds is monitored by serological examination of meat juice samples. The prevalence of salmonella in purchased feed is monitored by bacteriological examination of feed samples after heat treatment. The aim of this study was to estimate the salmonella prevalence in Danish pig herds by examination of blood and faecal samples and to estimate the prevalence of salmonella in feed when fed to the pigs. Among 96 randomly selected Danish finishing herds, S. Typhimurium was isolated from pen samples from 14 herds (14.6%). In these herds, the proportion of positive pens ranged from 0.1 to 0.5. Non-S. Typhimurium was isolated from pen samples from 8 herds (8.3%) in which the proportion of positive pens ranged from 0.1 to 1.0. In feed samples, S. Typhimurium was isolated from 1 sample. Non-S. Typhimurium was isolated from feed in 25 herds (26%). The proportion of positive feed samples ranged from 0.1 to 1.0. In 39 herds (40.6%) no sero-positive pigs were found. In 39 herds (40.6%) the proportion of positive pigs was between 0 and 0.2. In 18 herds (18.8%) the proportion of positive pigs was above 0.2.