DISTRIBUTION OF SALMONELLA ON 23 PIG FARMS IN THE UK

DAVIES R H* WRAY C

Since 1990 Salmonella typhimurium DT104 has been increasing dramatically in the UK in man and in food animals there was a parallel increase, which peaked in 1995, in cattle and more recently in pigs and poultry. (Gresham 1996). There was a four fold increase in S. typhimurium isolates from pigs between 1987 and 1994 and most of the current disease associated strains show multiple antibiotic resistance. Although the relationship between human disease and contaminated pig meat is not certain, the organism has regularly been isolated from a variety of pig meat products. In one large human outbreak multi-resistant S. typhimurium DT193 was traced back to pork products from a local infected herd (Maguire et al 1993). CVL’s studies have suggested a high prevalence of infected batches of fattening pigs but the individual prevalence is not known and is likely to average between 5 and 30% (Berends et al 1996). This variability may be related to the time of acquisition of infection before slaughter and the opportunity for cross-infection during transport and in the lairage (Fedorka-Cray et al 1994, Gray et al 1996). Improved disease security and hygiene methods on pig farms have shown some success in reducing the incidence of salmonella contamination of pig carcasses in Denmark, and such measures will ultimately be self-financing because of improved overall pig performance (Dee et al 1996). Wildlife vectors are also likely to be important (Muirhead 1993). The study described in this paper was designed to determine the distribution and persistence of multi-resistant S. typhimurium on pig farms, to investigate the role of other animals and wildlife pests in the infection and to assess the effect of management interventions where possible.

MATERIALS AND METHODS

Twenty-three pig farms were visited by Veterinary Laboratories Agency staff. Representatives of outdoor and indoor breeding herds, breeder-fatteners, rearers and fatteners were included in the study. Farms were identified on the basis of the isolation of multi-resistant S. typhimurium from porcine samples submitted to the local Veterinary Investigation Centre for examination. Farmers were then contacted and given the opportunity to participate in the project.

Fifteen to 20 gram bulk faeces were taken from every individual pen of pigs on the farm using large gauze surgical swabs (Robinson Healthcare) which had been autoclaved within 225ml Buffered Peptone Water (BPW; Oxoid CM509) in Honey jars. Equipment, vehicles, domestic pets and other livestock and wildlife were also sampled. The swabs were then returned to the jars which were kept at ambient temperature until the return to the laboratory on the same day, when the jars were incubated at 37°C for 18 hours. 0.2ml was then inoculated into the centre of a plate of Modified Semi-solid-Rappaport-Vassiliadis medium (MSRV; Difco 1868-7) containing 20µg ml⁻¹ Novobiocin. This was incubated at 41.5°C for 24 hours after which a 10µl loop was used

* Bacteriology Department, Central Veterinary Laboratory, New Haw, Addlestone, Surrey KT15 3NB, UK
to inoculate a Rambach agar (Merck 7500) plate which was incubated at 41.5° for 24 hours. Suspect colonies were then confirmed by full serotyping.

Statistical analysis: Probability values were obtained by using the Chi-Squared test (with Yates’ correction) on the EPI-Info statcalc programme.

RESULTS

Table one shows the Salmonella isolation results from bulked faeces samples from adult pigs taken on two visits to each of the farms.

Table One: Prevalence of S. typhimurium and other Salmonella serotypes in Adult Pig groups

<table>
<thead>
<tr>
<th>Type of Farm</th>
<th>No. Farms</th>
<th>Giltss</th>
<th>Boars</th>
<th>Post Weaning Sows</th>
<th>Farrowing Sows</th>
<th>Dry Sows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeder Farm</td>
<td>15</td>
<td>79[34]/387 (20.4)[8.9]</td>
<td>19[18]/142 (13.4)[13.4]</td>
<td>21[112]/486 (4.3)[23.0]</td>
<td>86[140]/120 (7.2)[11.6]</td>
<td>56[78]/867 (6.4)[9.0]</td>
</tr>
</tbody>
</table>

[ ] = Salmonellas other than S. typhimurium

Gilts and boars were most heavily infected with S. typhimurium compared with adult sow groups. Boars and post weaning sows were most heavily infected with other salmonella serotypes. The prevalence of S. typhimurium in pens of growers and fatteners was higher on breeder/fattener farms than on specialist fattening farms:

Table two: Prevalence of S. typhimurium and other Salmonella serotypes in growing pigs.

<table>
<thead>
<tr>
<th>Type of Farm</th>
<th>No. Farms</th>
<th>Weaners</th>
<th>Nurse pens</th>
<th>Growers</th>
<th>Fatteners</th>
<th>Sick Pens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeder/Rearer Farm</td>
<td>15</td>
<td>272[124]/851 (32.0)[14.6]</td>
<td>37[73]/76 (48.7)[9.2]</td>
<td>219[64]/589 (37.2)[10.9]</td>
<td>201[32]/454 (44.3)[7.0]</td>
<td>16[94]/40 (40.0)[22.5]</td>
</tr>
<tr>
<td>Specialist Fattener Farm</td>
<td>8</td>
<td>N/A</td>
<td>0/1</td>
<td>73[70]/269 (27.1)[26.0]</td>
<td>158[52]/640 (24.7)[8.1]</td>
<td>3/10 (30.0)</td>
</tr>
</tbody>
</table>

[ ] = Salmonellas other than S. typhimurium
(p<0.01) although other salmonella serotypes were more common. The prevalence of salmonella in growers and fatteners was significantly lower on all in-all out batch farms compared with continuously occupied units. Improved disinfection of weaner and grower pens on some of the farms also produced a significant reduction in the incidence of salmonella positive batches (eg. from 80% to 11% on one farm). On one specialist fattening farm strategic medication with neomycin on arrival reduced the subsequent pen prevalence from 96.3% to 18.5% (p<0.01) and vaccination of breeding stock with an inactivated *S. typhimurium/S. dublin* vaccine on another farm was associated with a reduction of salmonella from 67% to 12% in weaned pigs and from 52% to 5% in the adult sector of the herd. (p<0.01).

Wildlife were also heavily involved in the herd infection, especially on breeding farms where there were larger populations of wild animals.

Table three: Prevalence of *S. typhimurium* and other salmonella serotypes in cats and farm wildlife.

<table>
<thead>
<tr>
<th>Type of Farm</th>
<th>No. Farms</th>
<th>Cats</th>
<th>Rats</th>
<th>Mice</th>
<th>Wild birds</th>
<th>Foxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeder Farm</td>
<td>15</td>
<td>8[3]/38</td>
<td>7[3]/33</td>
<td>18[15]/64</td>
<td>48[15]/184</td>
<td>9[1]/30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(21.0) [7.9]</td>
<td>(21.2) [9.1]</td>
<td>(28.1) [23.4]</td>
<td>(26.1) [8.1]</td>
<td>(30.0) [3.3]</td>
</tr>
<tr>
<td>Specialist Fattener Farm</td>
<td>8</td>
<td>1/2 (50.0)</td>
<td>2/19 (10.5)</td>
<td>0/8</td>
<td>9[2]/61</td>
<td>(14.7) [3.3]</td>
</tr>
</tbody>
</table>

[ ] = Salmonellas other than *S. typhimurium*

Cats and birds in particular were associated with contamination of feed and grain stores and rodents were involved in perpetuation of infection in specific buildings on the farm. Infected foxes were most common on outdoor breeding farms.

A total of 20 different salmonella serotypes and 15 different *S. typhimurium* determinative types were isolated from the 23 farms. Several salmonella serotypes (up to 7) and *S. typhimurium* determinative types (up to 5) were co-existing at the same time on many of the farms.

**DISCUSSION**

The high level of antibiotic resistance in Salmonella from pigs (MAFF, 1996) has been a cause for concern for some time. This and the uncertainty about the origin of the human epidemic of *Salmonella typhimurium* and the level of salmonella in the UK pig industry, in the absence of a recent slaughter survey, has prompted a search for new information. The farms visited in this study were selected on the basis of identification of clinical disease, and so may have had a higher prevalence of infection within the herd than average. It was not possible to visit
any control herds to confirm this but the diversity in salmonella serotypes and *Salmonella typhimurium* phage types found on most of the individual farms in this study suggests that salmonella carriage may be widespread.

Observations made in these studies suggest that substantial improvements can be made in gilt and service management as well as general husbandry and hygiene so that the chance of infected pigs being despatched for slaughter is reduced. Improved disinfection of weaner and grower pens and operating all-in-all out batch farm systems appeared to lead to improvements in the level of salmonella contamination on many of the farms. Higher concentrations of disinfectant than are commonly used are required and combination disinfectant products comprising formaldehyde, glutaraldehyde and quaternary ammonium compounds were the most effective in our studies. On one farm vaccination led to a short term improvement but the situation relapsed in the absence of any concurrent management improvements or frequent revaccination.

In the long term improved design of pig accommodation to allow houses to be run on an all-in all-out basis and to avoid shared dunging passages and scrapers will benefit salmonella control but may be expensive to implement. It is easier to limit the spread of the organism in slatted housing systems than in straw bedded pens unless these are run on a deep litter basis. As slatted systems are likely to be replaced with more welfare friendly systems consideration must be given to avoiding the possible increased level of enteric disease and carriage of foodborne zoonotic organisms. Control of Salmonella on outdoor breeding units is likely to be extremely difficult and more research is required in this area.

ACKNOWLEDGEMENT

This work was funded by MAFF, UK.

REFERENCES


