

Effect of pig production system and transport on the potential pathogen transfer risk into the food chain from Salmonella shed in pig faeces

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Abstract

The prevalence of faecal Salmonella shedding has been compared in organic, conventional outdoor, and indoor finishing pig herds in a Danish survey with participation of 34 herds. Individual faecal and meat juice samples were collected from 30-50 pigs per herd and analysed for presence of Salmonella, and Salmonella antibodies, respectively. The results showed a low level of on-farm Salmonella shedding (<0,2 %) in organic and conventional outdoor herds compared to 2,5 % in indoor pigs ($P<0,0001$), and also a lower prevalence of Salmonella shedding in outdoor systems at slaughter (<2 %) compared to 4,1 % in indoor systems ($P<0,01$). The overall seroprevalence was 8,5 % with no significant differences between systems. Seropositivity was a significant predictor of Salmonella shedding at slaughter in individual pigs from conventional systems, but not in organic pigs. The duration of transport did not affect the risk of Salmonella shedding at slaughter.

Introduction

Pork and pork products are recognised as one of the major sources of human salmonellosis (Lo Fo Wong et al. 2002, Wegener and Baggesen 1996). Pigs in outdoor production systems benefit from a low animal density, and access to outdoor area, and organic pig production furthermore differs from conventional production in terms of feeding, weaning age, and use of preventive medication (Bonde and Sørensen 2004). It is therefore likely that the risk of Salmonella is different in organic, outdoor, and indoor pig production, respectively. The level of Salmonella shedding at slaughter might differ between the production systems, caused by differences in the level of resistance to the pathogen, which may be due to the immune system based disease resistance and/or components of the husbandry systems affecting disease development and pathogen shedding (see e.g. review by Zheng et al, in press).

Jensen et al. (2004) found a higher prevalence of Salmonella antibodies in outdoor than indoor pig production systems. In a survey by Hald et al. (1999) the proportion of seropositive pigs tended to be higher in conventional "free-range" production systems compared to pigs from either organic or indoor production systems. On the other hand Meyer et al. (2005) reported that conventional slaughter pigs were more likely to be seropositive than organic pigs. The presence of antibodies indicates that the pig has been exposed to challenge by the enteric pathogen at some stage of its development. Stege et al. (2000) reported a herd level association between high seroprevalence and presence of Salmonella in faecal samples from the herd.

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A number of stress factors related to the routine management in a pig herd may increase faecal shedding of pathogens. Further, transport of pigs to the abattoir causes significant stress to the animals, which can trigger an increase in shedding (e.g. Lo Fo Wong et al. 2002), and duration of transport and lairage may also affect the level of *Salmonella* shedding at slaughter (Morgan et al., 1987). It is therefore essential to compare the faecal shedding before and after transport to the abattoir, when assessing the risk of pathogen transfer into the food chain.

The objective of this survey is to investigate the effect of different pig production systems with indoor or outdoor rearing, and the effect of transport duration, on the potential pathogen transfer risk into the food chain from *Salmonella* in pig faeces. Further we evaluate seropositivity as a predictor of *Salmonella* shedding at pig level.

Materials and methods

Eleven organic, 12 conventional outdoor and 11 indoor fattening pig herds were included in the survey. During a one-year period faecal samples were collected in each herd from 3-5 batches of 10 randomly chosen and individually marked pigs 1-7 days before slaughter, and the animals were clinically examined. Further, meat juice samples and samples of caecal content from these pigs were collected at the abattoir. Faecal and caecal samples were analysed qualitatively for density of enteric *Salmonella* using the modified NMKL method. Meat juice samples from each pig were examined for specific antibodies against *Salmonella enterica* using an indirect enzyme-linked immunosorbent assay (ELISA) (Nielsen et al., 1998). The ELISA combined several *S. enterica* O-antigens, and allowed detection of antibody response after a variety of different *S. enterica* serovar infections. Samples with an OD%>10 were considered seropositive. Data was analysed in SAS in a log-linear model (Proc GENMOD). Information about duration of transport to slaughter was collected from 155 batches of pigs (50 organic, 58 conventional outdoor, and 47 indoor batches), and differences between systems were analysed in SAS by Proc GLM.

Results

The prevalence of *Salmonella* in the different production systems is illustrated in Fig. 1. The overall prevalence of *Salmonella* in 1609 faecal samples from pigs on-farm was 0,87 %; the systems were significantly different ($P<0,0001$). The prevalence of *Salmonella* shedding was 2,2 % in 1556 of these pigs at slaughter, with a significant difference between systems ($P<0,01$). Shedding of *Salmonella* on-farm was significantly predicting shedding at slaughter ($P<0,0001$). Seropositivity was also a significant predictor of *Salmonella* shedding at slaughter ($P<0,005$), and tended to predict on-farm shedding ($P<0,10$). Overall 8,5 % of the pigs were seropositive with no significant differences between systems. Neither of the clinical parameters, e.g. diarrhoea, constipation or poor body condition, acted as significant predictors of *Salmonella* shedding.

The duration of transport is illustrated in Fig. 2. The mean durations of transport to slaughter were 175,3 min (organic pigs), 128,6 min (conventional outdoor pigs) and 96,8 min (indoor pigs) ($P<0,0001$). The differences in transport did not affect the *Salmonella* shedding at slaughter.

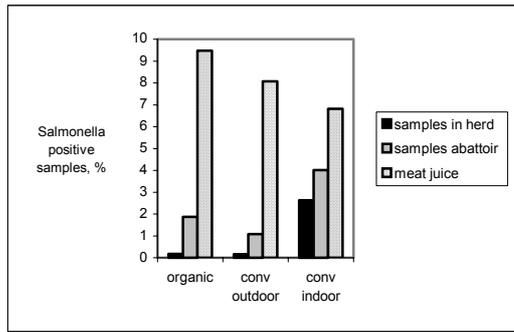


Figure 1. Prevalence of Salmonella shedding on-farm and at slaughter, and prevalence of Salmonella antibodies in meat juice.

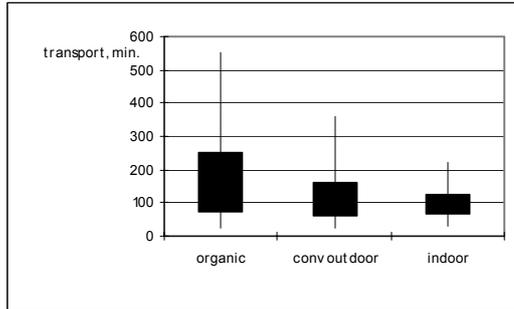


Figure 2: Duration of transport to the abattoir: min, max, 25% and 75% quartiles of the transport duration in minutes for the three pig production systems.

No significant interactions between system and seropositivity were found in relation to Salmonella shedding. Analysis of each production system separately showed that Salmonella shedding at slaughter in conventional outdoor pigs was predicted by seropositivity ($P < 0,01$). In indoor pigs it was predicted by on-farm shedding ($P < 0,0001$), as well as seropositivity ($P < 0,10$). Contrary to this, Salmonella shedding in organic pigs was not predicted by seropositivity.

Discussion and conclusions

We found similar seroprevalences in outdoor and indoor systems, while Hald et al. (1999), Jensen et al. (2004), and Meyer et al. (2005) each found differing results regarding seroprevalence. The prevalence of Salmonella shedding in pigs from outdoor systems was less than in indoor herds. The low levels of Salmonella shedding in organic and outdoor pigs suggest that pigs from low input systems may be more resistant to the pathogen, or may encounter the infection earlier in life so they have cleaned themselves from infection at time of slaughter. The observed differences in transport duration did not affect the risk of Salmonella shedding at slaughter. The lack of association between Salmonella shedding and clinical symptoms is in agreement

with Stege et al. (2000) reporting predominantly subclinical salmonellosis in Danish finishing pigs. Seropositivity as a means to identify individual pigs that are more likely to shed *Salmonella* might be better suited to conventional than organic herds.

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