Longitudinal study of *Salmonella enterica* serovar Typhimurium infection in three Danish farrow-to-finish swineherds

Søren Kranker, Lis Alban*, Jaap Boes

National Committee for Pig Production, Danish Bacon & Meat Council, Vinkelvej 11, DK-8620 Kjellerup, Denmark. Phone: 45-87 71 40 54. Fax: 45-87 71 40 05. E-mail: lia@danishmeat.dk

**Summary:** A longitudinal study on *Salmonella enterica* was carried out in 3 Danish farrow-to-finish swineherds in 2001. Litters from each herd were divided into 2 cohorts of 30 pigs each (180 pigs in total). Individual pigs were examined for bacteriology and serology monthly from weaning to slaughter. At weaning, individual sows were also examined for bacteriology and serology. In total, 88 pigs were found to be shedding on ≥1 occasion. Only *Salmonella enterica* serovar Typhimurium was detected. The culture-prevalence peaked in the nursery, and subsequently declined to undetectable levels before slaughter. The sero-prevalence peaked approximately 60 days after peak culture-prevalence. *Salmonella* was detected in individual fecal samples at least once in 53% of the pigs, while 62% were sero-positive more than once. Only 3.7% of all pigs were found to be culture-positive on ≥1 occasion. The average shedding time was estimated to have been 18 days.

**Keywords:** transmission, dynamics, duration of infection, animal health, surveillance

**Introduction:** To ensure food safety, continuing efforts are needed to reduce the occurrence of *Salmonella* in pork. In order to achieve this, information about the dynamics of *Salmonella* infections in swineherds over time (e.g. duration of infection and disease transmission patterns) is important. However, so far only limited information about this aspect of *Salmonella* infection has been available. Therefore, a longitudinal study of the infection dynamics of *Salmonella enterica* was carried out in three Danish farrow-to-finish swineherds. The aim was to elucidate the complex nature of sub-clinical *Salmonella* infections at herd and pig level. Particularly, the association between bacteriological shedding and serological response in cohorts of pigs from weaning to slaughter was investigated.

**Materials and Methods:** Three farrow-to-finish swineherds with moderate to high levels of *Salmonella* were selected for the study, based on serological and bacteriological data from the national *Salmonella* surveillance program in Denmark. To ensure that *Salmonella* was present in all age groups, pooled pen fecal samples were collected prior to the start of the study. To account for variations in *Salmonella* shedding over time, litters from each herd were divided into 2 cohorts that were raised with approximately 1-month intervals. Each cohort consisted of 30 pigs each, yielding a total of 180 pigs. Individual pigs were examined for bacteriology and serology monthly from weaning to slaughter. At weaning, individual sows were also examined for bacteriology and serology. Finally, cecal-content samples, ileo-cecal lymph nodes, and carcass swabs were obtained from 131 pigs at slaughter. Serological examinations were performed using the Danish Mix-ELISA with a cut-off level of OD%>20. Feces were cultured using standard microbiological methods, including non-selective pre-enrichment, selective enrichment and serotyping.
Results: In total, 88 pigs were found to be shedding on one or more occasions. On all three farms, only *Salmonella Typhimurium* was isolated during the study period. At weaning, no sows or piglets were found to be shedding, but serological reaction was detected in 11 sows. The culture-prevalence peaked in the nursery, and subsequently declined to undetectable levels before slaughter. The sero-prevalence peaked approximately 60 days after peak culture-prevalence (Fig. 1). *Salmonella* was detected in individual fecal samples at least once in 53% of the pigs, while 62% were sero-positive more than once. Only 3.7% of all pigs were found to be culture-positive on more than one occasion. Marked differences in culture- and sero-prevalences between cohorts and within herds were observed. Piglets from sero-reacting sows had a significantly (P<0.05) lower probability of being shedders in the nursery. Under the assumption that shedding had started 0.5 week before the first positive fecal sample, and lasted until at least 0.5 week after the last positive fecal sample, the average shedding time was estimated to have been 18 days.

Discussion: There are several explanations for time of onset and course of *Salmonella* shedding: (a) piglets became infected in the farrowing unit, without shedding; (b) protecting factors in the farrowing unit had a reducing effect on *Salmonella* shedding by piglets; (c) weaning stress triggered shedding in the nursery; (d) residual infection was present in the nursery despite cleaning and disinfection; (e) contaminated tools, boots, etc. were present in the nursery. The last two explanations seem most likely, as it has been shown that strategic movement of pigs at weaning can eliminate infection (Dahl et al., 1997).

Infection spread to most of the population, but less than 4% of the pigs were found to be culture-positive on more than one sampling occasion (fecal samples were taken at 4-week intervals), indicating an average duration of infection of 2-3 weeks. Furthermore, during the finisher stage *Salmonella* shedding decreased with age (Figure 1). This implies, that the *Salmonella* prevalence among finishers from a herd infected with *Salmonella* can be low or negligible at the time of slaughter, reducing the risk for human health.

References: