

## PAPER

# Use of an avirulent live *Salmonella* Choleraesuis vaccine to reduce the prevalence of *Salmonella* carrier pigs at slaughter

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## Context

*Salmonella enterica* is one of the major foodborne pathogens transmitted by pork, and a decrease in the number of carrier pigs at slaughter is considered to be the first step in achieving *Salmonella*-free pork products. Vaccination may be a viable approach for shortening the time required to decrease the number of herds with a high infection rate through increasing resistance to *Salmonella* in susceptible pigs.

The SC-54 attenuated strain of *Salmonella enterica* serovar Choleraesuis var Kurzendorf was obtained after repeated passages of a virulent strain in pig neutrophils, resulting in the loss of the *spv* gene from the virulence plasmid. Trials conducted on artificially inoculated pigs demonstrated that this strain is safe and able to protect animals from infection. This study evaluated the use of the vaccine produced with the SC-54 strain in a herd with a high prevalence of *Salmonella*, with the aim of reducing the number of *Salmonella* carriers at slaughter.

## Main conclusion

Administration of the *S* Choleraesuis attenuated vaccine to pigs in the first day of life decreased the isolation of *Salmonella*, as well as the seroprevalence in pigs at slaughter.

## Approach

Seven batches of 500 pigs were included in each of two study groups: the vaccinated group (VG) was orally vaccinated on the first day of life, and the control group (CG) received a placebo. The groups were managed in a three-site system and followed up from birth to slaughter.

Blood samples ( $n=378$ ) were collected from each pig at one, 21 and 49 days of age to monitor the on-farm seroprevalence in both groups. Before housing in the nursery, one drag swab was taken in 10 pens per room to monitor residual *Salmonella* contamination. At 49 days of age (nursery) and at 143 days of age (finishing), pooled faecal samples were collected from all batches in each group in order to detect faecal shedding. Mesenteric lymph nodes and blood from animals ( $n=390$ ) in each group were collected at slaughter. Serum samples were analysed by an indirect ELISA-LPS test to detect anti-*Salmonella* IgG antibodies. *Salmonella* isolation was performed as specified by ISO 6579.

Logistic regression was used to test the relationship between vaccination and seroprevalence or *Salmonella* isolation from the mesenteric lymph nodes at slaughter. Overdispersion was corrected by Williams' method. Values of  $P<0.05$  were considered significant.

## Results

On the first day of life, the seroprevalence in the CG batches ranged from 77.9 to 96.3 per cent, while in the VG batches it ranged from 66.6 to 92.6 per cent. At weaning, the number of seropositives had decreased in both groups (mean of 12.0 per cent for CG and 3.7 per cent for VG).

Five nursery facilities had environmental samples that were positive for *Salmonella* before the allocation of pigs, and both groups were exposed to a similar challenge. At 49

days of age, only one batch of VG pigs had positive faecal samples. At the finishing phase, most batches belonging to both experimental groups had at least one *Salmonella*-positive pooled faecal sample. However, the number of positive pools was lower in batches of VG pigs (median 1) compared with CG pigs (median 3).

At slaughter, batches of VG pigs had a significantly ( $P<0.0001$ ) lower seroprevalence (mean 46.6 per cent) and isolation of *Salmonella* from lymph nodes (33.1 per cent) compared with CG batches (79.7 and 59.5 per cent, respectively). Vaccinated batches had a lower odds of having pigs at slaughter that were positive for *Salmonella* isolation from lymph nodes (odds ratio [OR] 0.33, 95 per cent confidence interval [CI] 0.19 to 0.57) and in ELISA testing (OR 0.20, 95 per cent CI 0.09 to 0.42).

## Interpretation

In this study, oral administration of the SC-54 strain vaccine to one-day-old piglets was evaluated in a vertically integrated system with a history of high seroprevalence ( $>70$  per cent) and *Salmonella* isolation at slaughter. Vaccinated and control batches, followed in a longitudinal study, showed a similar pattern of transmission and seroconversion.

One-day-old piglets in both groups had a high seroprevalence, possibly due to the transfer of maternal antibodies in colostrum. The disappearance of maternal antibodies coincided with transfer to the nursery. In addition, the residual environmental contamination of the nursery facilities and co-mingling with unvaccinated pigs could have contributed to *Salmonella* transmission. In spite of this, after 28 days in the nursery only three batches of 49-day-old pigs were detected with a (low) prevalence of seropositive pigs, and only one cohort from the VG group was shedding *Salmonella*, indicating that most of the pigs were either negative for *Salmonella* or the animals were still in the initial stages of infection.

At the finishing site, the pigs started to shed *Salmonella* in their faeces, in line with the amplification in the number of infected animals often observed at this stage. However, the vaccinated group showed a lower number of positive faecal pools, which may have resulted from a lower number of infected animals due to the protection conferred by vaccination. At slaughter, all batches vaccinated with the SC-54 strain had seroprevalences below 70 per cent, whereas the control batches had a significantly ( $P<0.0001$ ) higher number of seropositive pigs. The VG pigs showed a significant reduction ( $P<0.0001$ ) in the frequency of *Salmonella* isolation from mesenteric lymph nodes, demonstrating that vaccination had had a protective effect.

## Significance of findings

In herds with a high prevalence of *Salmonella*, vaccination with the SC-54 strain can be considered as an additional management tool to reduce the number of carriers in a shorter period of time, although changes in management and addressing risk factors remain essential for achieving the target of a low prevalence in *Salmonella* control programmes.