Immunophylaxis as a method to help reduce the incidence of *Salmonella* infection in swine

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Abstract: Swine reared for fattening which were clinically proven to have salmonellosis (*S. typhimurium*) were immunized with a *S. typhimurium* live vaccine to prevent clinical disease and reduce the level of infection amongst the swine. To assess the outcome of vaccination the ileocaecal lymph nodes of the swine were removed at the time of slaughter and cultures set up to establish the presence of salmonella. In addition, serum samples were taken and assayed for antibodies to *S. typhimurium*. Use of the vaccine prevented animals from developing clinical disease and resulted in a marked reduction in the isolation of *S. typhimurium* from the ileocaecal lymph nodes of the swine at slaughter and in the number of animals with high antibody value (≥40 OD%).

Keywords: vaccination, *S. Typhimurium*, control, prevalence, live vaccine

Introduction: The German authorities have drafted legislation, to reduce the presence of salmonella in meat from slaughtered animals. The draft legislation requires serological investigation of meat juices using a LPS-antigen ELISA (cut off ≥ 40 OD%). This draft legislation also embraces measures to be implemented in swine-rearing facilities in which the animals have high antibody titres. The aim of this study was to investigate the effect of the use of a live *S. typhimurium* vaccine in a swine population with clinical disease and more than 40 % seroprevalence of Salmonella among the slaughtered animals.

Materials and Methods: The swine population was a fattening one with piglet production and rearing under "all-in-all-out"-management. Cases of clinical salmonellosis, caused by infection with *S. typhimurium*, had been seen since May 1998. A total of 575 sows and their young (16,356 piglets) were vaccinated between August 1998 and January 2000. The vaccine was based on a double-attenuated strain of *S. typhimurium*, phage type DT 9, containing the serotype-specific plasmid of 60 MDa. This strain can be distinguished from field strains of the same serotype on the basis of its auxotrophy, using a rapid test (Salmonella Diagnostic Kit from IDT GmbH) and molecular biology methods (Schwarz et al.,
1995). As far as possible all sows were given one dose of the vaccine \((\geq 5 \times 10^8\) cfu) at 6 and again at 3 weeks \textit{ante partum} by the subcutaneous route. All viable piglets were given a single dose by the oral route on day 21 \textit{post partum} and a single dose by the intramuscular route in week 7 \textit{post partum}. For evaluation purposes the ileocaecal lymph nodes were removed from a representative number of swine to be slaughtered before and after use of the vaccine. The tissue samples were pre-enriched in buffered peptone water (Merck), followed by selective multiple enriching by the method of Waltmann et al. (1993). Colonies suspected of being salmonella were investigated biochemically and by serotyping using corresponding anti-salmonella sera (SIFIN, Berlin). The wild-type strain distinguished from the vaccine strain using the IDT Salmonella Diagnostic Kit. Between August 1998 and August 1999 the serum samples were tested for the presence of antibodies to \textit{S. typhimurium}. Seroconversion was investigated using ELISA (Steinbach et al., 2000; Nielsen et al., 1998), as required by the drafted Swine Salmonella Legislation using a lipopolysaccharide (LPS) mixed antigen of \textit{S. typhimurium} and \textit{S. choleraesuis}. Extinction was measured at a serum dilution of 1:400 and converted into OD% based on standard sera on each plate.

**Results:** No appreciable local or systemic signs of a failure to tolerate the vaccine were seen after subcutaneous vaccination of the sows and after oral/intramuscular vaccination of the young. No clinical cases of salmonellosis were seen after vaccination. The percentage of animals positive for salmonella before vaccination varied between 7.95 and 41.12%. The corresponding range after vaccination was 1.14 - 4.26% (Table 1). In the course of serology studies before vaccination (August and November 1998) \(\geq 40\%\) of the samples had antibody values of at least 40%. After vaccination less than 10% of the animals had antibody values of 40% or above (Table 1).

**Discussion:** As a result of the use of a live \textit{S. typhimurium} vaccine there were no clinical cases of salmonellosis in the animal population. The swine population was not entirely free of salmonella at the end of the study. This may be due to the continued presence of salmonella organisms in older sows which were infected prior to vaccination. There was, however, a marked reduction in the level of isolation of \textit{S. typhimurium} from the ileocaecal lymph nodes in the swine at the time of slaughter. The extinction values seen at a serum dilution of 1:400 correspond to those in meat juice diluted 1:30 (Nielsen et al., 1998; Käsbohrer et al., 1998). They can therefore be used directly to assess the status of animals in a salmonella eradication programme. Prior to vaccination \(\geq 40\%\) of the samples had antibody values of at least 40% (= cut off). After vaccination the percentage of animals with an antibody value of at least 40% fell to below 10%. The population
has now a low salmonella status. At the same time it was apparent that animals slaughtered from February 1999 did not in any instance have antibody values which would warrant their classification as “salmonella positive“ under the definitions of the Danish and German eradication programs. These results correlate with those of experimental studies (Springer et al., 2000), which demonstrated that oral vaccination with the live vaccine elicited an immunological reaction, but did not result in antibody values ≥ 20 OD%.

In conclusion, the use of the *S. typhimurium* live vaccine prevents cases of clinical salmonella disease and results in a reduction in the persistence of the salmonella organisms in the animals which is of epidemiological relevance.

Tab. 1: Isolation of *S. typhimurium* from the ileocaecal lymph nodes and seroprevalence of Salmonella (using 40 samples of N) before and after vaccination (since 02/99) with Salmopor.

<table>
<thead>
<tr>
<th>time of investigation</th>
<th>07/98</th>
<th>08/98</th>
<th>11/98</th>
<th>12/98</th>
<th>02/99</th>
<th>03/99</th>
<th>05/99</th>
<th>08/99</th>
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<tr>
<td>N</td>
<td>107</td>
<td>88</td>
<td>95</td>
<td>94</td>
<td>88</td>
<td>69</td>
<td>94</td>
<td>87</td>
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<td>% pos. sample in bact. culture</td>
<td>41.12</td>
<td>7.95</td>
<td>13.68</td>
<td>12.77</td>
<td>1.14</td>
<td>2.90</td>
<td>4.26</td>
<td>3.45</td>
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<tr>
<td>seroprevalence in %</td>
<td>not inv.</td>
<td>40</td>
<td>42.5</td>
<td>not inv.</td>
<td>7.5</td>
<td>7.5</td>
<td>7.5</td>
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References


