Proliferative Enteropathy (Ileitis) in Finisher Pigs: An Evaluation of Vaccination in Live Production in the USA

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Introduction

Proliferative enteropathy is a common enteric disease of post-weaned pigs, caused by the obligately intracellular bacterium *Lawsonia intracellularis*. Genome and protein analysis of this bacterium indicates a remarkably homogenous or monotypic “single strain”. The presentation in affected post-weaned animals can include reduced weight gain of varying degree with or without diarrhoea, due to proliferative enteropathy lesions in the ileum and colon. In pigs older than 12 weeks, such as finisher pigs, more acute clinical signs can also occur, with the proliferative lesions accompanied by rapid onset of diffuse haemorrhages from the affected mucosa, leading to melena and sudden death. Epidemiologic studies have indicated that the type of farm operation has a significant effect on the age of onset of proliferative enteropathy. So-called multiple-site farms with strict separation of age groups (breeding, post-weaning nursery period and finishers) generally have a later onset of acute or chronic disease, such as in the middle to late finishing period.

Economics of Ileitis in pigs

Previous studies have estimated the economic losses due to the clinical and subclinical effects of proliferative enteropathy in unmedicated pigs (reduced weight gain, inefficient feed conversion, inefficient space utilization, carcass downgrading and morbidity-mortality effects) may range from $2.50 to $10 per affected pig, depending on variable factors such as facility and feed prices. Because antibiotic medication programs are still in wide usage around the world to control proliferative enteropathy, the aim of a new series of studies was to compare the biologic performance of a large number of vaccinated and medicated pigs in controlled groups of naturally-exposed pigs on several farms.

Enterisol® Ileitis in growing pigs

Five large-scale multiple-site farms from various swine raising areas of the USA were selected for vaccination after repeated bouts of diarrhoea, mortality and weight loss in the finishing period (12 to 28 weeks-old). Several finishing pigs on each farm had infection with *Lawsonia intracellularis* and associated lesions confirmed by routine autopsy, histopathology and PCR techniques at independent swine diagnostic facilities. As such, the study sites were considered to be likely to be challenged exposed to the bacterium via infected feces. Finishing pigs in each farm were derived in large batches from a farm-specific source of “nursery” pigs at 10 to 12 weeks old. Sites were classified as finisher-to-market, or “grow-outs”, with no breeding animals or younger pigs from the same source within 2 km. Several sites were traditional grow-finish (e.g. 23 kg to market weight), while several others were finisher only (e.g. 45 kg to market weight). On each study site, separate buildings were filled at one time and thus housed one large group of pigs from 12 to 28 weeks of age, see Table 1. The PRRS sero-status of farm 5 was negative, while the remaining farms were positive for PRRS serum antibodies in the finishing period.

Vaccine was delivered to groups of 6 to 10 week-old pigs, although the product is licensed for usage in pigs 3 weeks or older. It was administered via the drinking water over one 4-hour period, starting at approximately 09:00. At that time on the day prior to intended vaccination, the group’s 4-hour drinking water consumption was estimated via water disappearance from their water supply. A combination of vaccine, edible food dye and chlorine inhibitor were added to the total volume of water calculated previously for consumption in 4 hours, administered via a proportioner at 1:128, and made available as the sole immediate supply to the vaccinate pigs as a group via the on-farm water system. To avoid altering the drinking pattern and to prevent any welfare concerns, study pigs were not subjected to withholding of water prior to this vaccination process. The dye was used to monitor vaccinated water flow, which was continued until all this water was consumed.
The vaccine is a live attenuated bacterium; therefore the 7-day antibiotic-free period is necessary to provide a minimum 3-day period both before and after vaccination day to prevent coincidental presence of inhibitory substances in the intestines of vaccinates.

Three main performance parameters were collected for each group of finisher pigs: average daily weight gain (ADWG), feed conversion and mortality (deaths per 100 pigs). Total animal weight was determined at entry and exit, when pigs were approximately 12 and 28 weeks-old. Group feed consumption was measured. Each group recorded average weight gain (kg/d) and feed conversion ratio (kg of feed consumed/kg of weight gain). On some farms, group diarrhoea treatment incidents (when >10% of group pigs were affected) and the number of doses of water-soluble antibiotic used were noted. Breeding suitability, the % of pigs culled for poor reproductive conformation parameters, were noted in gilt grow outs utilized for the study. The pigs were not individually monitored for individual animal effects; these parameters are the subject of separate studies, some of which have been reported elsewhere.

Performance observations and analysis

Farm 1 exhibited clinical Ileitis in non-vaccinated groups. The remaining farms did not exhibit clinical Ileitis for control groups during the study period. One barn of vaccinated pigs exhibited diarrhoea shortly after vaccination, suggesting vaccine was not provided soon enough to pigs prior to exposure to the field organism.

Mortality rates during the study were reduced by 39.9% in vaccinates with reduced medication programs compared to fully medicated controls, see Table 1. Average daily weight gain of vaccinates was significantly improved in all trials, on average 6.1% (p<0.05). Feed conversion was nominally (farms 1,3,4; p>0.05) or significantly improved (farm 2,5; p<0.05) in all

Table 1. Biologic data of groups of finisher pigs (12 to 28 weeks-old) at 5 study sites, comparing vaccinates, reduced medicated and fully medicated controls.

<table>
<thead>
<tr>
<th>Study farm number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers of groups per farm - Enterisol Ileitis</td>
<td>10*</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>- Control</td>
<td>10*</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Average daily weight gain/pig in (g/d)</td>
<td>703.7a</td>
<td>749.1a</td>
<td>903.5b</td>
<td>898.9b</td>
<td>880.8b</td>
</tr>
<tr>
<td></td>
<td>853.5a</td>
<td>839.9a</td>
<td>835.4a</td>
<td>744.6a</td>
<td></td>
</tr>
<tr>
<td>Average feed conversion ratio per pig in each group (kg feed consumed per kg bodyweight gain)</td>
<td>2.97a</td>
<td>2.89a</td>
<td>2.90a</td>
<td>3.03a</td>
<td>2.90a</td>
</tr>
<tr>
<td></td>
<td>3.04a</td>
<td>3.04a</td>
<td>2.92a</td>
<td>3.04a</td>
<td>3.05a</td>
</tr>
<tr>
<td>Mortality over the finishing period</td>
<td>2.01a</td>
<td>1.05a</td>
<td>1.06a</td>
<td>0.84a</td>
<td>2.49a</td>
</tr>
<tr>
<td>(no. of deaths in each group per 100 pigs)</td>
<td>3.07a</td>
<td>1.54a</td>
<td>1.63a</td>
<td>2.04a</td>
<td>3.74a</td>
</tr>
<tr>
<td>Number of diarrhoea treatment incidents in the finishing period</td>
<td>1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

NA = not available.
* For each parameter, the top line represents the value for vaccinate/reduced medication groups and the bottom line value that for the fully medicated group.
* Means with different superscripts are different at p values listed: ab p<0.05, ac p<0.01 ad p=0.06
vaccinated groups, as compared to groups with continuous feed medications. Batch to batch variability, as measured by the coefficient of variation (SD of ADWG/mean of ADWG) was reduced by 15% in vaccinated pigs. The number of diarrhoea medication incidents in the finisher period of farm 1 was markedly reduced from 27 days in the unvaccinated group (8 barns) to only one in the vaccinated group (12 barns). The number of pigs removed during the study for poor reproductive suitability was similar in both groups on farm 5 at 5.8% culled in vaccinated compared to 5.6% culled in the medicated groups.

Intestinal tissues from pigs on farm 2 were routinely submitted for post mortem. Vaccinated pigs were 8 times less likely to be infected with \textit{Lawsonia intracellularis}, as indicated by antigen detection (PCR, IHC) as compared to fully medicated control pigs. This evaluation was made by odds ratio analysis, and may explain some of the performance benefit achieved by vaccination as compared to medication. It is possible that vaccine-enhanced growth is due to each vaccinated pig acquiring a specific targeted “natural” T-cell immunity that stops early infection with the wild-type strain\textsuperscript{16}.

**Discussion**

The study farms had previously experienced important clinical and subclinical problems with poor and uneven performance, diarrhoea and deaths in the finishing period, due to proliferative enteropathy, for which full medication control programs had been developed. Side-by-side comparison of these medication programs with vaccination (Enterisol\textsuperscript{®} Ileitis vaccine, frozen form) and over 50% reduction of those medications indicated that the latter program was not only safe and controlled the clinical problems, but was also more effective at improving actual biologic parameters in the finishing periods. This led to a demonstrable improvement in the performance of the vaccinated groups. In contrast to many interventions that add costs to production, use of vaccination for proliferative enteropathy allowed cost reduction, because targeted feed medications were removed or greatly reduced in vaccinated groups of pigs and fixed costs per kg gain were reduced as well.

Numerous vaccinated pigs in different groups over 5 farms all showed a significantly enhanced growth rate and nominal to significantly improved feed conversion compared to fully medicated finisher pigs. In contrast, the pathogenic effects of wild-type \textit{Lawsonia intracellularis} within the intestine, including hyperplasia of the crypts, reactive inflammation and interruption of current nutrient flow in the intestine would have been unimpeded in their early and middle stages in many pigs by the use of medications at times unrelated to exact points of each pig’s infection, or by those medications unable to completely prevent infections. The vaccine may thus prevent the many negative effects of proliferative enteropathy on feed nutrient absorption, particularly amino acid uptake, across a whole group of pigs\textsuperscript{11, 12}. In a broader sense, the vaccine may act to reduce the presence of a major pathogen load of the wild-type strain on a farm.

In these studies, a major reduction in feed medications targeting ileitis was achieved in vaccinated groups. The percentage of rations non medicated, as a percent of the total kg of feed per pig, ranged from 46 to 83% during the study\textsuperscript{14}. Most reduction in medications came late in the finishing phase, where higher average feed intake occurs.
References

15. Otteke, S; Dee, SA; Rassow, KD; Joo, HS; Deen, J; Maltorp, TW; Pijuan, C. Transmission of porcine respiratory and reproductive virus by needles. Vet Rec 2002; 150: 114-115.
16. George, MH; Heinrich, PE; Dexter, DR; Morgan, JB; Odde, KG; Glock, RD; Tatum, JD; Cowman, GL; Smith, GC. Injection-site lesions in carcasses of cattle receiving injections at branding and at weaning. J An Sci 1995; 73: 3235-3240.