Reduction of antimicrobials by use of vaccination
- the ileitis experience -

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Abstract
Porcine Enteropathy also known as ileitis in pigs, caused by *Lawsonia intracellularis*, is regarded as one of the major gut related health issues in pork production. Recent reports from national institutes for pharmaceutical products show that the annual amount of antibiotics against enteric diseases has increased over the last few years. Despite the ban of antimicrobial growth promoters in Europe since January 2006, the total amount of antibiotics used in pigs does not seem to be significantly reduced. This is contradictory to the demands of the consumers for a reduction in antibiotic use and the efforts to reduce the risk of antibiotic resistance. Recently several field studies have demonstrated that the use of Enterisol® ileitis (Boehringer Ingelheim), a vaccine against ileitis can reduce the amount of antibiotics needed to prevent this disease. Additionally, vaccination can contribute to the overall reduction in use of antimicrobials on farms due to the higher health status of the farms. This oral vaccine is therefore a better alternative compared to antibiotics to prevent ileitis.

Introduction
In the past few years, the political situation on antimicrobial use in agriculture has changed. According to Wagstrom (2006), "the issue of antimicrobial use in food animals has in many ways moved out of the arena of scientific debate, and into the arena of consumer activism". This statement is based on the increasing presence of consumer groups on the internet and other open sources which question the way food producing animals are kept and raised. In Europe the ban on antimicrobial growth promoters (AGP) was started in Sweden and Denmark. The results were a drastic reduction in the overall tonnage in preventive antimicrobials, with a shift to more therapeutic use of antimicrobials especially against enteric diseases. Since then, an increase in overall antibiotic usage has been reported in Denmark (Danmap 2005). New problems have arisen with the link between Methicillin resistant *Staphylococcus Aureus* bacteria and swine production (Voss et al. 2005). This problem has recently led to media coverage on national television in the Netherlands (Zembla 2006).

The use of vaccines in swine production has demonstrated over the years to be a good alternative for antibiotics for many diseases. In the year 2000 Boehringer Ingelheim introduced Enterisol® ileitis, the first and only vaccine against ileitis caused by *Lawsonia intracellularis*, in the United States market. Since then, this vaccine has obtained marketing authorisation in most of the major pig producing countries throughout the world. In multiple trials the potential of Enterisol® ileitis for the reduction of antibiotics is investigated.

Study 1 - Mexico
Materials and methods
This study was performed in northern Mexico. The production system was a multiple-site farm with 4000 sows. A total of 11 weekly production batches were evaluated; 7 control groups and 4 vaccinated groups. Production parameters were evaluated using standard statistical process control methods. Criteria evaluated included: Average daily weight gain (ADWG), Feed efficiency (FE), Age at market, Weight at market, and Percent Culls.

Treatment procedures for each group were as follows:
Group 1: The control group used a pulse feed medication program during the entire finishing phase (body weight in parentheses):
- Tylosin 110 ppm/carbadox 55 ppm (12-25Kg).
- Tylosin 88 ppm/carbadox 27.5 ppm (25-40kg)
- Tylosin 40 ppm/salinomycin 60 ppm (40-60kg)

Group 2: Pigs were given a live vaccine against *Lawsonia intracellularis* (Enterisol® ileitis), vaccinated at 5 weeks of age in the nursery by oral administration. Additionally a reduced pulse medication program was implemented:
- Tylosin 88 ppm/carbadox 55 ppm (25-40 kg)
- Salinomycin 60 ppm (40-60 kg).

Results
Vaccinated pigs grew nearly 15% faster than conventionally medicated pigs (Table 1).

### Table 1: Production Parameters and % Improvement

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control</th>
<th>Vx El</th>
<th>Dif</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of pigs (n)</td>
<td>14.752</td>
<td>8.145</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADWG (g)</td>
<td>758</td>
<td>863</td>
<td>+105</td>
<td>+14</td>
</tr>
<tr>
<td>FC (kg/kg)</td>
<td>2.65</td>
<td>2.60</td>
<td>-0.05</td>
<td>-2</td>
</tr>
<tr>
<td>Market Weight (kg)</td>
<td>87.88</td>
<td>98.33</td>
<td>+10.45</td>
<td>+12</td>
</tr>
<tr>
<td>Market age (d)</td>
<td>143.91</td>
<td>139.05</td>
<td>-4.86</td>
<td>-3</td>
</tr>
<tr>
<td>Mortality site 3 (%)</td>
<td>4.54</td>
<td>3.56</td>
<td>-0.98</td>
<td>-22</td>
</tr>
<tr>
<td>Culls (%)</td>
<td>7.16</td>
<td>3.79</td>
<td>-3.37</td>
<td>-47</td>
</tr>
</tbody>
</table>

Other parameters showing improvement include mortality, market weight and age, and cull rates. Feed efficiency remained unchanged even with total antimicrobial use reduced by 35% in vaccinated pigs.

**Figure 1:** Statistical Process Control (SPC) chart of ADWG pre and post vaccination.

![Figure 1](image)

**Study 2 - USA**

**Materials and methods**

A production system, typical for the Midwestern U.S., raises approximately 2.5 M pigs per year, out of a total US production of 100 M pigs. The average sow farm size is 4000 sows, with approximately 1500 new gilts per farm per year. Nursery and finishers are housed separately off site (multi-site production). Most finishing barns have deep pig manure storage over slatted floors, though 20% are shallow pits with "pull plug" systems. In this large a production system, health controls, like any management programs, must be standardized, simple and repeatable to apply, and deliver consistent results, with little added treatments needed.

The history of enteric disease in the pigs included all common pathogens seen in commercial pig production - feed induced diarrhoea, gastric ulcers, Salmonellosis, PCV-2, nonspecific colitis, hemorrhagic bowel syndrome, torsions and endemic TGE (transmissible gastroenteritis virus). These conditions were diagnosed by routine pathology and histopathology. Both the
chronic/Proliferative Intestinal Adenomatosis (PIA) form and acute/Porcine Haemorrhagic Enteropathy (PHE) form are present in the system. Chronic diarrhoea historically began in commercial pigs from 70 kg/150 lb to market, in the finishing barn. Hemorrhagic ileitis would occur in some groups of pigs around the first marketing cut, and in replacement gilts after placement into sow farms, at around 33 weeks of age.

Control of *Lawsonia intracellularis* and other enteric diseases was attempted with feed grade medications. In nursery pigs, a system of carbadox, tiamulin/chlortetracycline and chlortetracycline alone was used. This continues today for its broad spectrum respiratory and enteric benefit. Control of *Lawsonia intracellularis* in finishing was based on several combinations of tylosin, either at 100 ppm followed by 40 ppm, or 40 ppm continuously from 35 to 60 kg. Breaks on this medication program occurred frequently, at an average of 70 or more enteric cases per month. Water soluble tylosin was used as the first treatment option. When cases would not respond, water therapy was changed to tiamulin.

The goal for use of Enterisol® Ileitis was to reduce overall in-feed and water medication use, and, with similar cost, improve clinical control of disease in both high value replacement gilts and finishing pigs. Replacement gilts were the first target for vaccination given their cost and the poor response to treatment of PHE cases. Vaccination of these animals began in 2001. Following success in these animals, vaccine was tested in finishing pigs in 2002, with pigs vaccinated at 12-14 weeks of age, just following placement into finishing.

Results
Vaccination has dramatically altered the feed medication program in finishing pigs and replacement gilts. Routine use of both in-feed tylosin as well as growth promoting antibiotics has dropped to zero (see figure 2). The numbers of groups needing treatment for diarrhea of any kind has been reduced over 75% (<15 cases/month now) even with the removal of all in-feed medications (100 % reduction). This has made health management much simpler at the field supervisor level, as well as in the feed mill.

### Figure 2: Effect of Enterisol ileitis vaccination on the use of feed grade tylosin.

![Feed grade Tylosin vs. Enterisol ileitis vaccine](image)

**Study 3 - Germany**

**Materials and Methods**
This longitudinal study was executed in a farrow-to-finish farm of 1,600 sows and 10,000 fattening places. The control group consisted of 16,032 pigs out of 32 fattening groups that were slaughtered between November 2004 and July 2005. The 13,848 slaughtered, Enterisol® ileitis vaccinated pigs belonged to 27 groups. They reached slaughter between May and November 2005. All pigs were housed under identical conditions. The monitored parameters for the fattening period were ADWG (average daily weight gain), FC (Feed conversion ratio), mortality, and amount of antibiotic used against enteric diseases (AB use). The gross margin (GM) indicates the possible economical benefit of the vaccination based on prior performance parameters.
Results

Table 2 summarizes the results, which showed significant improvement in all parameters. Not only a reduction of the overall level of antibiotic use is shown, but additionally to table 2 an increased level of control in pig production in this farm is seen since vaccination started. Furthermore, an economic benefit, expressed as Gross Margin of €6.37 was generated.

Table 2: Average growth performances, antibiotic use and Gross Margin (GM) in vaccinated pigs versus non-vaccinated controls.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Vaccinated</th>
<th>Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADWG g/day</td>
<td>738</td>
<td>766</td>
<td>+28***</td>
</tr>
<tr>
<td>FCR g/g</td>
<td>3.16</td>
<td>2.98</td>
<td>-0.18***</td>
</tr>
<tr>
<td>Mortality %</td>
<td>4</td>
<td>2.8</td>
<td>-1.2***</td>
</tr>
<tr>
<td>AB use Kg/group *</td>
<td>2.23</td>
<td>1.03</td>
<td>-53%***</td>
</tr>
<tr>
<td>Av. GM / pig (€)**</td>
<td>25.34</td>
<td>31.71</td>
<td>+6.37</td>
</tr>
</tbody>
</table>

* AB use for therapeutic treatment of enteric diseases
**Assumptions: Feed price 170 €/T; Piglet price 57 € or 1.93 €/Kg if < 30 Kg; Pig price 1.44 €/Kg
***Significantly different with a p-value < 0.001

Conclusion

The results show a broad improvement in groups of vaccinated pigs. Even with a reduction of antimicrobial use, pigs grew faster and more consistently. These studies demonstrated that producers may have the option of eliminating finishing dietary antimicrobial use while reducing input costs and maintaining performance similar to or better than continuously medicated, non-vaccinated pigs. An overall reduction of 35 to 100 percent of in-feed antibiotics was realized. As restrictions on antimicrobial use continue to increase, pork producers will need more options for controlling diseases like ileitis which have traditionally accounted for much of the need for antimicrobial use. Use of Entersol® ileitis to control ileitis is a biologically feasible, environmentally responsible and economically attractive alternative to continuous feeding of antimicrobials.

Acknowledgments

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