

Tierärztl. Umschau 61: 372-376 (2006)

Report from the field

Comparison of the effects of oral vaccination and different antibiotic prophylactic treatments against *Lawsonia intracellularis* associated losses in a finishing pig unit with high prevalence of porcine proliferative enteropathy (PPE).

by M. Y. C. Thaker and G. Bilkei

(I Table, II References)

Short title: Prophylaxis against enteropathy

Key words: Swine - enteropathy -vaccination - mortality - culling -daily gain

Abstract

The aim of the present study was to compare the effects of oral vaccination and feed medication against *Lawsonia intracellularis* (LI) on the performance of growing-finishing pigs in a large Hungarian production unit with a high prevalence of LI infection. Pigs testing positive for LI infection were randomly divided into 4 groups and treated as follows:

- Group one: growing pigs ($n = 3810$) were vaccinated against LI infection after entry into the growing-finishing unit with an avirulent live oral vaccine (Enterisol® Ileitis Boehringer Ingelheim Vetmedica, Inc., St. Joseph, USA).
- Group two: growing pigs ($n = 3799$) received feed medicated with doxycycline (200 pp. doxycycline hyclate, Primadox® 50, ufamed AG, CH-6210 Sursee, Switzerland) over a 3-week period after entry into the growing-finishing unit.
- Group three: growing pigs ($n = 3810$) received chlortetracycline hydrochloride (500 ppm), tylosin tartrate (100 ppm) and sulphadimidine sodium (1000 ppm) feed medication (SK 40 ad us. vet., Biokema, CH-1023 Crissier, Switzerland) during a 3-week period after entry into the growing-finishing unit.
- Group four: growing pigs ($n = 3809$) were not treated.

Culling and mortality rates, reasons for culling and mortality, and average daily weight gain during the entire growing-finishing phase were evaluated. Porcine proliferative enteropathy (PPE) associated culling and mortality rates were lower (1.1%, 1.3% and 1.4% in groups 1-3, vs. 7.0% in the control group, $P < 0.05$). Both vaccinated and feed-medicated pigs had lower non-PPE associated culling and mortality rates compared with the non-vaccinated pigs (2.1%, 2.3% and 2.5% vs. 5.9%, $P > 0.05$). Average daily weight gain was greater ($P < 0.05$) both in the LI vaccinated and feed-medicated groups of pigs compared with the untreated pigs (799 ± 49 g, 767 ± 48 g and 757 ± 39 g vs. 650 ± 92 g). The present results indicate that both LI vaccination and feed medication at the beginning of the growing-finishing phase of the production, does not only prevent PPE, but might also result in more resistance and tolerance against other infectious diseases and multifactorial diseases.

1 Introduction

Porcine proliferative enteropathy (PPE), caused by *Lawsonia intracellularis* (LI), is an economically important disease that affects swine populations throughout the world (Bona and Bilkei, 2003). Clinical signs include poor growth, diarrhea and cachexia in growing pigs, and bloody diarrhea and sudden death in finisher pigs and young breeding stock (Guedes et al., 2002). Kroll et al. (2004) categorized the disease into two different clinical pictures: porcine intestinal adenomatosis (PIA) in growing pigs and proliferative hemorrhagic enteropathy (PHE) in finisher pigs and young breeding stock. The German literature (Pohlenz, 2005) has classified PPE into four different forms: acute (PHE), chronic (PIA), subclinical (necrotic enteritis (NE)) and regional ileitis (RI). There are many management methods such as outdoor bred pig systems (Bona and Bilkei, 2003), strict hygiene, depopulation (Guedes et al., 2002), and biotechnical methods (antibiotic prophylaxis and metaphylaxis (Schwartz et al., 1999), vaccination (Kroll et al., 2004)) to reduce or minimize the losses caused by PPE. A recently marketed avirulent oral live LI vaccine caused protective immunity (Kroll et al., 2004). There is a lack of field results about the comparative long-term effect of feed medication and vaccination against PPE in large production units.

2 Materials and method

2.1 Animals, management

This study was carried out in a large pig production unit (10,000 finishing pigs) in Hungary. This unit consisted of 20 identical finisher units, each with 500 pigs. The pigs were typical pigs for this geographical region, F2 crosses (sow line: Landrace x Large white, Duroc boar line). The stock was supplied from six breeding herds in close proximity (within a radius of 10 km, belonging to the same organization) at 9-11 weeks as growing pigs with an average weight of 28.3 ± 2.7 kg. In all the breeding stock, the piglets were weaned at 4 weeks (27.9 ± 2.1 d; 8.01 ± 1.6 kg). The weaned piglets were reared in the same unit in flatdeck housing in groups of 10 - 12 under identical environmental conditions, management and feeding. The pigs were fed on an ad libitum basis in the finishing unit with the usual commercial feed for this region (Table 1). The finisher pigs were housed in identical pens (10-13 pigs per pen; $0.9-1.2$ m² / pig) from entry into the unit until slaughter (103.4 ± 3.1 kg). The duration of the finishing period was between 93 (G1) and 115 days (G4). The daily gains were determined by deducting the weight at the start of finishing from the final weight and dividing this figure by the number of finishing days. The computer-controlled temperature control system maintained the temperature at 21 - 24 °C and the relative air humidity at 70-75%. Each pen was partially slatted (1/5 of the pen). The drinking water supply was automatic with two drinking nipples in each pen.

2.2 State of health

Both the breeding herds and the finishing unit had recorded high losses from PPE since 2004 (ban on antibiotic growth promoters in this organization). In the breeding herds, the cause of mortality was diagnosed by anatomical pathology and to some extent (approx. 10% of the mortality rate) by serology as PPE during the first 4 weeks after weaning from May 2004 to May 2005, $10.2 \pm 2.9\%$ and in the finishing unit during the entire production cycle, $14.1 \pm 3.2\%$.

Before the start of this study, 18 cachectic weaners (3 from each breeding herd) were gently euthanized with a barbiturate injection shortly before transfer to the finishing unit and underwent anatomical pathology, bacteriological, microscopic and serological examination. These "pre-trial" examinations showed:

- High levels of *Lawsonia* (determined by modified Ziehl-Nielsen staining as described by Love et al. (1977)),
- No *rotavirus* (latex agglutination tests),
- No "*transmissible gastroenteritis*" virus (fluorescence antibody test),
- Low levels of coccidia (flotation),
- Low numbers of *Brachyspira* spp. (silver staining of the colon swabs),
- Moderate growth of *Escherichia* (*E. coli* F4 and F18, and STa, STb and LT enterotoxins (checked using the "Fimbrex" diagnostic test kit, Weybridge, UK),
- Low numbers of *Actinobacillus* (*A. suis*, *Haemophilus parasuis*, *Streptococcus suis* and *Staphylococcus hyicus*) were diagnosed bacteriologically and microscopically,

Weight	Digestible energy	Raw protein	Lysine/ Cystine	Methionine	Phosphor	Calcium	Raw fibre;
g/kg							
20 - 65	13.7	180	10.9	69	5.5	7.3	3.1
65 - 105	13.5	160	9.55	67	4.5	6.3	3.5

- Classical swine fever and African swine fever were not serologically diagnosed,
- Low numbers of *Salmonella choleraesuis* were diagnosed bacteriologically and microscopically,
- ELISA test with Tween-20 Detergent-extracted antigen revealed low values of mycoplasma infection,
- ELISA to determine the bacterial antigens for *A. pleuropneumoniae* serotypes 1,2,5,1 and 9 yielded positive results,
- Mild, non-toxin producing *Pasteurella multocida* infections were determined,
- Swine influenza virus immunofluorescence antibody test was negative.

Before the start of the study and at the end of the flatdeck phase, the piglets were tested for LI seroprevalence by indirect immunofluorescence antibody (IFA) in 10% of the animals to be transferred to the finishing unit and the tested piglets were marked in sequence with a permanent marker (Vet Invest, Zagreb, Croatia) (Kroll *et al.*, 2004). According to Schwartz *et al.* (1999), IFA has a higher sensitivity and specificity for LI infections. One week after the IFA tests, the piglets were transferred to the finishing unit.

2.3 Treatment

In the finishing unit the pigs were separated into 4 groups in each accommodation unit and treated as follows at entry:

- *Group 1*: Finishing pigs (n = 3810 growing pigs) were vaccinated with an oral LI avirulent live-culture vaccine (Enterisol® Ileitis, Boehringer Ingelheim Vetmedica, Inc., St. Joseph, USA).
- *Group 2*: Finishing pigs (n = 3810 growing pigs) were administered oral doxycycline for 3 weeks (200 pp. doxycycline hyclate, Primadox® 50 ad us. vet., UFA, CH-6210 Sursee, Switzerland).
- *Group 3*: Finishing pigs (n = 3810 growing pigs) were administered oral doses of chlortetracycline hydrochloride (500 ppm), tylosin tartrate (100 ppm) and sulphadimidine sodium (1000 ppm) feed medication (SK 40 ad us. vet., Biokema, CH-1023 Crissier, Switzerland) during a 3-week period.
- *Group 4*: Finishing pigs (n = 3809 growing pigs) were not treated.

Four weeks after the treatment, the pigs were tested again by LI IFA.

Losses due to PPE were assumed when previous records of the animals indicated occurrence of clinical diarrhea, the circumstances of the death did not indicate any signs of other diseases and post mortem revealed the presence of typical pathological changes in the small intestine.

2.4 Statistics

The reasons for emergency culling and mortality and the average daily gains from entry to slaughter were assessed by chi-square analysis.

3 Results

All LI IFA tested piglets in the breeding herd were LI IFA seropositive. After transfer to the finishing units and after treatment, all previously LI IFA positive and marked pigs were still LI seropositive.

Porcine proliferative enteropathy (PPE)-associated culling and mortality were lower (1.1%, 1.3% and 1.4%) in groups 1 - 3 compared with the control group (7.0%, $P < 0.05$). Both the vaccinated pigs and the pigs treated with antibiotics had lower rates of non PPE-associated culling and mortality compared with the control group (2.1%, 2.3% and 2.5% vs. 5.9%; $P > 0.05$). The mean daily gains were higher ($P < 0.05$) in the groups with LI vaccination and antibiotic treatment compared with the untreated control animals (799 ± 49 g, 767 ± 48 g and 757 ± 39 g vs. 650 ± 92 g).

4 Discussion

The aim of the vaccination and prophylactic feed medication was to prevent or minimize LI-associated losses and increase daily gains. In addition to the expected significant reduction in LI-associated losses in animals receiving the vaccination or the

feed medication, these animal groups also experienced a reduction in non PPT-associated losses.

These results justify the conclusion that the oral vaccination against LI can also have a nonspecific positive effect on other multifactorial diseases. It appears that the better overall health and immune status of the pigs increased tolerance levels and boosted resistance. Mortality rates in finishing units in the same region vary between 1.6% and 8% (*Baumann and Bilkei, 2002*). The higher rates of mortality and emergency culling (altogether 12.9%) of the control animals in this study were higher than the average for this region.

In the present study only 10% of the pigs were tested by LI IFA. In view of the fact that all tested animals were LI seropositive, it can be assumed that despite the small number of animals examined, the serological results are highly likely to be representative for the entire herd. The maternal immunity for LI can persist for several weeks after weaning (*Guedes and Gebhart, 2003*). LI seropositivity during the suckling period and after weaning at the beginning of the flatdeck phase is due to maternal immunity (*Guedes and Gebhart, 2003*). Conversely, LI seropositivity at the end of the flatdeck phase possibly indicates a new infection (*Just et al., 2002; Lawson and Gebhart, 2000*). Therefore, in this study the 9-11 week pigs could have acquired LI seropositivity as a result of a new infection. There are conflicting opinions about vaccinating weaner pigs against LI while maternal antibodies are still circulating. Whereas *Kroll et al. (2004)* are of the opinion that regardless of the maternal antibodies, the weaner pigs are successfully vaccinated against LI, other authors (*Lawson and Gebhart, 2000*) recommend only vaccinating weaner pigs against LI once the maternal antibodies have been completely eliminated.

The present results indicate that in herds with high PPE infection pressure, both the LI vaccination and the feed medication significantly reduce losses. The results also illustrate that the oral LI vaccination - compared with the feed medication - yields better numerical (although not significant) results. All prophylactic measures reduced not only the PPE-associated losses, but also the non PPE-associated losses. This is probably the result of an improvement in the general state of health which leads to increased resistance and better tolerance against infectious diseases or multifactorial diseases.

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Author's address:

Dr. Goran Bilkei, DVM, PhD, Bilkei Consulting, Bahnhofstraße 42, CH-8600 Dübendorf/Switzerland
E-mail: bilkei.consulting@gmx.net

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