Lawsonia intracellularis -
Diagnostics and management of the disease in practice

Professor Ken Steen Pedersen
Department of Veterinary and Animal Sciences
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Antimicrobial use in food producing animals | Denmark

Figure 4.2 Distribution of live biomass and antimicrobial consumption in main animal species, tonnes, Denmark

- **Live biomass**
  - Cattle > 1 year, 39%
  - Pigs, 43%
  - Cattle < 1 year, 7%
  - Horses, 5%
  - Poultry, 1%
  - Fur Animals, 2%
  - Pet animals, 1%
  - Aquaculture, 2%

- **Active compound**
  - Cattle > 1 year, 10%
  - Horses, 1%
  - Poultry, 1%
  - Fur Animals, 4%
  - Pet animals, 1%
  - Other, 2%
  - Aquaculture, 3%

DANMAP 2018
Antimicrobial consumption in Danish Pig production

2009-2018: Overall reduction = 32%
Research focus on intestinal diseases in growers because of high AM use

**Consumped Standard doses, 2017**
- Sows & Piglets: 28%
- Weaners: 27%
- Finishers: 45%

**Ordinationsgroup, weaners, 2017**
- Gastrointestinal: 79%
- Respiratory: 9%
- Joints, limps, CNS: 12%
- Others: 0%
Current situation - diarrhoea and antibiotic use

- Weaning
- Two weeks
- 2500ppm Zn
- 30kg (7-8 weeks), move to finisher
- Week 3 + 4
- Week 6 + 7
- Diarrhoea in week 3-7
Treatment of intestinal diseases in Danish herds

Often by clinical indications

Treatment length 3-5 days

Water medication most common

Treatment initiated by farmer
<table>
<thead>
<tr>
<th>Consistency score</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Firm and shaped</td>
<td>Soft and shaped</td>
<td>Loose</td>
<td>Watery</td>
</tr>
<tr>
<td>Picture</td>
<td>![Picture 1]</td>
<td>![Picture 2]</td>
<td>![Picture 3]</td>
<td>![Picture 4]</td>
</tr>
<tr>
<td>Shape</td>
<td>Sausage</td>
<td>Vary form sausage shape to small piles</td>
<td>Tends to level with surface. Does not flow through or flows slowly through slatted floors.</td>
<td>Levels with surface. Flows through slatted floors.</td>
</tr>
<tr>
<td>In container</td>
<td>Preserves original shape.</td>
<td>Does not flow when container is rotated. Preserves original shape.</td>
<td>Inert when container is rotated. Merges and covers up bottom of container in most cases.</td>
<td>Flows easy when container is rotated. Merges and covers up bottom of container.</td>
</tr>
</tbody>
</table>
Facts of *Lawsonia intracellularis*

The cause of Porcine Proliferative Enteropathy
Obligate intracellular bacteria, only culture able in cells
Crypt epithelial cell proliferation
Characteristic feature of PE is mucosal thickening of the intestine
Considered highly prevalent worldwide

Histological pictures: [http://vetpath.wordpress.com](http://vetpath.wordpress.com)
Course of the Disease

- Inoculation
- Clinical signs
- Shedding: 12 wks
- Seropositivity: 13 wks
- Recovery
Other clinical signs than diarrhoea
Uneven growth, feed conversion reduced
LI excretion levels and impact on growth rate

Pedersen et al., 2012
LI excretion levels and impact on growth rate

<table>
<thead>
<tr>
<th>Weaners (compared with control pigs):</th>
<th>Finisher pigs (compared with control pigs):</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lawsonia cells/g faeces &gt; $10^6$</td>
<td>• Lawsonia cells/g faeces &gt; $10^5$</td>
</tr>
<tr>
<td>• ADG - Reduction of 20g/day for 19 days</td>
<td>• ADG - Reduction of 65g/day for 6-8 weeks</td>
</tr>
<tr>
<td>• Lawsonia cells/g faeces &gt; $10^7$</td>
<td>• Lawsonia cells/g faeces &gt; $10^7$</td>
</tr>
<tr>
<td>• ADG - Reduction of 110g/day for 19 days</td>
<td>• ADG - Reduction of 389g/day for 6-8 weeks</td>
</tr>
</tbody>
</table>

(Johansen et al., 2012; Pedersen et al., 2013)
LI excretion levels and impact on growth rate

Challenge trial

An excretion level of less than $10^6$ *L. intracellularis* per gram of faeces did not have a negative impact on ADG

Reduction in ADG (131 g/day) with an increase from $10^7$ to $10^8$ *L. intracellularis* per gram of faeces

Smaller ADG reductions were observed (15 g/day) when the number of *L. intracellularis* in faeces increased from $10^6$ to $10^7$ per gram of faeces

(Collins & Barchia, 2014)
Infection dynamics in herds

\[ y = 7.4x + 8 \]

\[ R^2 = 0.89 \]

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**Graph:**
- **X-axis:** Weeks post weaning
- **Y-axis 1:** Pct positive
- **Y-axis 2:** Kg

**Legend:**
- **Pink line:** Faeces
- **Yellow line:** Avr_weight
- **Blue line:** Blood
- **Red line:** Lin.reg (avr_weight)

**Equation:**
\[ y = 7.4x + 8 \]

**Coefficient of determination:**
\[ R^2 = 0.89 \]
Diagnosing LI infections in the individual pig
Routine diagnostic methods for *L. intracellularis*:

**Dead pigs**
- Gross pathology
- Histopathology
- Immunohistochemistry (IHC)/FISH
- PCR testing of mucosa/intestinal content

**Live pigs**
- Antibody detection
- PCR testing of faecal samples

10 years ago
Faecal PCR testing for *Lawsonia intracellularis*

Qualitative/dichotom PCR testing has overestimated the occurrence of *L. intracellularis* associated diarrhoea (Pedersen et al., 2010)

L. *intracellularis* → PCR testing → Detected/not detected, no information on the number of bacteria in faeces

A positive test result may not be related to the current outbreak of diarrhoea

L. *intracellularis* infection → Shedding for 2-4 weeks → E. coli diarrhoea
Diagnosing LI infections on herd level
Pooling of faecal samples is possible

20 individual faecal samples from 43 herds

Conclusion: qPCR results from a pooled pen floor samples represent average excretion levels from the pigs in the pen

Bland–Altman plot showing the difference between 43 laboratory and theoretical pools in relation to the number of log10 Lawsonia intracellularis bacteria/g feces (Pedersen et al., 2014).
Sock sampling | method

Pedersen et. al. 2015
When to test for impact on production?

Infected pigs were typically shedding at 10-12 weeks of age and continued to shed for 2-6 successive weeks.

Most pigs had seroconverted 2 weeks subsequent to the sampling where they were first shedding LI.

5 Danish pig herds

(Stege et al., 2003)
Using diarrhoeic status is a poor indicator for pathogen excretion

20 weaner herds examined on random days
97% of 2,866 pigs assessed to be clinically healthy
32.6% within herd diarrhoea prevalence

<table>
<thead>
<tr>
<th>Pathogen detection</th>
<th>Diarrhoeic</th>
<th>Normal</th>
<th>Odds ratio</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. coli</em> F4</td>
<td>13.3%</td>
<td>12.2%</td>
<td>1.10</td>
<td>ns</td>
</tr>
<tr>
<td><em>E. coli</em> F18</td>
<td>11.9%</td>
<td>10.5%</td>
<td>1.07</td>
<td>ns</td>
</tr>
<tr>
<td><em>L. intracellularis</em></td>
<td>20.4%</td>
<td>20.2%</td>
<td>1.02</td>
<td>ns</td>
</tr>
<tr>
<td><em>B. pilosicoli</em></td>
<td>16.9%</td>
<td>16.7%</td>
<td>1.02</td>
<td>ns</td>
</tr>
<tr>
<td>None</td>
<td>51.4%</td>
<td>54.4%</td>
<td>0.89</td>
<td>ns</td>
</tr>
<tr>
<td>Single pathogen detected</td>
<td>35.9%</td>
<td>33.3%</td>
<td>1.12</td>
<td>ns</td>
</tr>
<tr>
<td>1+ pathogens detected</td>
<td>12.7%</td>
<td>12.3%</td>
<td>1.04</td>
<td>ns</td>
</tr>
<tr>
<td>Total</td>
<td>142</td>
<td>114</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Variation between batches

Prevalence (%) of pigs with *Lawsonia intracellularis* antibodies at slaughter
Causes of diarrhoea in Danish weaners

- No infection: 10%
- E. coli: 30%
- Lawsonia intracellularis: 10%
- Brachyspira pilosicoli: 5%
- E. coli + Lawsonia intracellularis: 15%
- E. coli + Brachyspira pilosicoli: 10%
- Lawsonia intracellularis + Brachyspira pilosicoli: 10%
- E. coli + Lawsonia intracellularis + Brachyspira pilosicoli: 15%
Other causes of diarrhoea

Bacterial
- Swine dysentery (*Brachyspira hyodysenteriae*)
- Salmonellosis (*S. Typhimurium*)

Viral
- PCV2
- Rotavirus
- TGE and PED

Others
- Unspecific diarrhoea (feed related, new agent?)
MANAGEMENT

Treatment and Prevention
Treatment strategies for Lawsonia

- Only the sick animals
- Single animal + batch medication (pen, section)
- Tiamulin, Tetracycline, Tylosin, others
- Resistance-assessment not possible
Doxycycline more effective in reducing *L. intracellularis* excretion than Tylosine (Weber et al., 2017)

Timing of treatment is important!

Early treatment before diarrhoea symptoms when **qPCR is positive** gives best growth (Weber et al., 2017)
Prevention of *Lawsonia intracellularis*

- Feed composition, protein levels, grinding, fibers
- Control of post-weaning diarrhoea
- Controlling other diseases occurring at the same time
- Vaccination against *Lawsonia intracellularis*
- All in/all out with wash, disinfection and drying out
- Hygiene
- Climate (cold, draught, moisture)
- Probiotics – expensive, varying effect
Transmission route is a challenge
Eradication programmes

• Only in cases where farms are (re)populated after total clean up, new establishment

• Only cases with Dan-bred SPF gilts older than 4 months
Eradication - Success rate

- 9 out of 11 farms became “clinically” free
- ELISA and PCR negative
- Dramatic reduction of antibiotic usage
- Production results excellent
  - Daily weight gain post-weaning +600 g
- Most farms re-infected within 1½-2 years!
Take home – *Lawsonia intracellularis*

- *Lawsonia intracellularis* is common and important cause of disease
- Mixed intestinal infections are common and Lab-investigations are necessary
- Quantitative PCR for assessment of impact on growth rate
- Timing is the most important in relation to antibiotic treatment
  - Feed very important for prevention
- Vaccination may be good solution on some farms