Zinc oxide ban must lead to improved pre- & post-weaning management

Peadar Lawlor & Carmen Villodre
Introduction

• Under license at 3.1 kg/t (2500 ppm Zn) for 14 days to treat PWD
• Thereafter, not greater than 150 ppm Zn
• EU will ban the use of ZnO in 2022
• Industry resistance - ZnO is very effective in treating PWD
• BUT, we must now look on this as an opportunity
  • Was it simply a ‘band-aid’ for suboptimal post-weaning management?
• Replacement for ZnO will take a multi-faceted approach
  • Improve pre & post-weaning management so that pig health is improved
  • Do correctly what we already know should be done!
  • Also a place for certain alternative feed additives
FACTS
1. Zinc Oxide ban in 2022
2. Litter size ↑ weaning weights ↓
3. NO one alternative for Zinc

Also FACT
1. Pigs can thrive post-weaning without Zinc Oxide
2. Management changes will also improve unit performance
3. OPPORTUNITY that we MUST capitalise on
1. Health

Improved hygiene

- Thorough sanitation
- Wash → disinfect with a chlorocresol product, allow to fully dry

Biosecurity

- Do you operate ‘Strict’ all-in /all-out’? REALLY?
  - Animals from different groups are never mixed
  - Rooms completely emptied, washed, disinfected and dried before introducing new pigs
- Health status of pigs will improve over time if strict all-in /all-out is implemented

Vaccination Programme
2. Wean heavier and healthier pigs
Weaning Age

- Early weaning ↑ sow productivity but with ↑ health/mortality problems and ↑ feed costs
- 1 day ↑ in weaning age = 500g at 28 days
- Younger pigs have a less developed gut
- More undigested feed in the gut of younger pigs
- \( E.\ coli \) counts higher in 3 week compared to 4 week weaned pigs
- 5 week weaning? – 4 weeks is a compromise

**Effect of weaning age on growth performance to 10 wks of age**

<table>
<thead>
<tr>
<th>Weaning age (wks)</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (%)</td>
<td>14(^a)</td>
<td>1(^b)</td>
<td>4(^{ab})</td>
</tr>
<tr>
<td>Average Daily Gain (g)</td>
<td>363(^a)</td>
<td>402(^b)</td>
<td>476(^c)</td>
</tr>
<tr>
<td>Average Daily Feed Intake (g)</td>
<td>560(^a)</td>
<td>621(^b)</td>
<td>680(^c)</td>
</tr>
<tr>
<td>Feed Conversion Ratio</td>
<td>1.57(^a)</td>
<td>1.55(^a)</td>
<td>1.43(^b)</td>
</tr>
<tr>
<td>Weight 10wks of age (kg)</td>
<td>24.4</td>
<td>24.7</td>
<td>26.7</td>
</tr>
</tbody>
</table>

Lawlor et al., 2003a; Leliveld et al., 2013
Weaning weight

- High intake in first week after weaning = high lifetime growth
- KEY: wean heavier pigs
- Birth-weight is King!
- Creep feed
  - Consumption frequently low, but
  - those that eat have ↑ post-weaning daily feed intake, and
  - ↑ post-weaning growth rates (Sulabo et al., 2010).
- Creep feed little and often from 10-12 days of age

Lawlor et al., 2002a
3. Nutrition
Reduced crude protein diets

- Prevents an excess of undigested protein reaching the large intestine
  - contributes to the growth of pathogens, such as *E. coli* and
  - the production of harmful compounds which negatively affect gut permeability
- Reduces the incidence of diarrhoea

But

- Requirements of weaned pigs for amino acids are high
  - for growth
  - also to counteract health challenges
- Therefore, low CP diets must be fortified with synthetic amino acids
- E.g. ↓ CP in post-weaning diets from 20.4 to 16.9% with correct synthetic amino acid supplementation ↓ diarrhoea, without affecting weight gain & protein deposition (Bellego and Noblet, 2002)
Promote Water intake

- More than a week after weaning to restore daily fluid intake
  - Suckling pig: \( \sim 680\text{ml} \) BUT....
  - 1\text{st} day post-weaning: \( \sim 290\text{ml} \)
  - 1\text{st} week post-weaning: \( \sim 442\text{ml} \)
  - 2\text{nd} week post-weaning: \( \sim 770\text{ml/pig} \)
- Restricted water flow: ↓feed intake and ADG by 15 %
- Supplementary drinkers in first week
- Drinker height, angle & position
- Bowl drinkers easier for pigs to find water
- Use same type as in the farrowing house
- Water quality?
Promote intake early post-weaning

- Intakes in 1st days after weaning don’t cover maintenance requirement, much less support pre-weaning rates of gain
  - Fat catabolism: energy for maintenance
  - ↓ in villous height - affects nutrient absorption
- Promote feed intake
  - Water!
  - Feeder space
  - Diets
  - Form

Lawlor, 2000; Lawlor et al., 2002
Feeding milk replacer post-weaning

- Feeding liquid milk not common due to cost
- Could ↑ intake and daily gain in critical days after weaning
- Feeding milk replacer plus starter diet for 4 days after weaning
  - ↑ daily gain by 20-30% in first week after weaning
  - ↑ intestinal villi *cf.* pigs weaned onto starter diet
- **Its all about intake in the first few days!**

Pluske et al., 1995; Zijlstra et al., 1996
4. Feed Additives

Alternatives to zinc oxide and antibiotics
Diet Acidification

- Insufficient levels of gastric acid - high stomach pH at weaning
- Protein digestion reduced
- Growth of diarrhoea-causing micro-organisms
- Feed intake $\uparrow \sim 32\%$ in week 1 and by 11% in 1st 3 weeks
- Response not always consistent – microbial challenge

**Effect of fumaric acid on intake & growth**

- Acid binding capacity
  - Alternative approach
  - Diet formulation
  - Use ABC values for ingredients
  - Ingredients differ in ABC
  - Similar effect to acids

Lawlor et al., 2005a; 2005b; 2006
Probiotics

Effect of feeding *Bacillus pumilus* for 22 days on post-weaning pig growth

<table>
<thead>
<tr>
<th></th>
<th>Non-medicated</th>
<th>Medicated</th>
<th><em>B. pumilus</em></th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 0 BW (kg)</td>
<td>8.7</td>
<td>8.6</td>
<td>8.8</td>
<td>NS</td>
</tr>
<tr>
<td>Day 22 BW (kg)</td>
<td><strong>18.1</strong></td>
<td><strong>17.6</strong></td>
<td><strong>18.7</strong></td>
<td>+</td>
</tr>
<tr>
<td>ADFI (g/d)</td>
<td>471</td>
<td>458</td>
<td>475</td>
<td>NS</td>
</tr>
<tr>
<td>ADG (g/d)</td>
<td>427</td>
<td>405</td>
<td>455</td>
<td>+</td>
</tr>
<tr>
<td>FCE</td>
<td>1.11&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>1.14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.05&lt;sup&gt;b&lt;/sup&gt;</td>
<td>*</td>
</tr>
</tbody>
</table>

- **Probiotics**: ‘Live microorganisms – adequate amounts - health benefit’
- Alternative to ZnO? - Control pathogens & ↑ growth
- Immune modulation, competitive exclusion & antimicrobial production
- ↓ *E. coli* in the gut like medicated treatment, but without ↓ growth and possible liver toxicity seen with Apramycin + ZnO

Casey et al. 2007; O’Sullivan et al., 2010; Prieto et al., 2013
Summary

- Ban on ZnO in 2022
- Must act now
- One intervention on its own is unlikely to be effective
- Multifaceted approach necessary
- Must improve pre- and post-weaning management
- Do correctly what we already know should be done!
### Quantity of starter and link to feed

- Must feed high density, **milk-rich** diets for fast and efficient lifetime growth
- But……expensive and overuse must be avoided
- Function: stimulate ↑energy intake after weaning and lifetime growth

#### Allocation of starter and link diets and growth

<table>
<thead>
<tr>
<th></th>
<th>Starter diet (kg)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>s.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link diet (kg)</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality (%)</td>
<td>10</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Weaning to 10 weeks of age**

<table>
<thead>
<tr>
<th></th>
<th>Daily Gain (g)</th>
<th>416</th>
<th>411</th>
<th>432</th>
<th>395</th>
<th>14.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Feed Intake (g)</td>
<td>620</td>
<td>610</td>
<td>653</td>
<td>596</td>
<td></td>
<td>21.8</td>
</tr>
<tr>
<td>Feed Conversion Ratio</td>
<td>1.51</td>
<td>1.52</td>
<td>1.52</td>
<td>1.52</td>
<td>0.038</td>
<td></td>
</tr>
</tbody>
</table>

- Also look at health & mortality
- Starter and link as low as 1 and 3kg respectively to heavy healthy pigs
- Light pigs will likely benefit from higher allocation
- Health problems - pigs will also benefit from higher allocation of starter & link

Lawlor et al., 2002a; 2003b; 2005a; Leliveld et al., 2013
9. Summary

- Acids, prebiotics, probiotics - alternatives to antibiotics/ZnO but response not predictable

- Good quality starter and link diets necessary for weaned pigs

- But....levels used should be geared towards pig weaning weight, health and optimization of lifetime growth

- Liquid feeding did not ↑ growth rate but ↑ feed wastage

- Feeding milk replacer for short period after weaning can greatly ↑ piglet growth and gut health

- Intake in first few days after weaning is the Key!
It is essential that we strive to improve pre- and post-weaning management to successfully overcome problems posed by the ban of zinc oxide.

Much of this involves doing correctly what we already know should be done!
Content

1. Weaning age
2. Wean a heavy pig but “Birth weight is king!”
3. Water intake
4. Push energy intake early post-weaning
5. Post-weaning diet - milk, cooking cereals, acids, probiotics, prebiotics
6. Quantity of starter and link to feed/feed budget
7. Liquid feeding
8. Feeding milk replacer post-weaning
9. Summary
5. Post-weaning diet

Level of milk products
- Expensive but very important constituents of post-weaning diets
- 5 days reduction in days to slaughter
- Mortality, incidence of scour and veterinary interventions ↓
- Lactose most important (response up to 32-47% inclusion)
- Benefit from substituting casein for soy protein after 2 weeks is small

Cooking cereals
- Responses to cooking maize and wheat are very variable
- Barley different – higher fibre content
- Where responses seen it may be due to a decontamination effect
- Use well screened grains with a low microbial load

Lawlor et al., 2003a; 2003b; 2005a
Feed intake to match pre-weaning energy intake

<table>
<thead>
<tr>
<th>DE of Diet</th>
<th>14.5</th>
<th>15.5</th>
<th>16.5</th>
<th>17.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning age</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth weight</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weaning weight</th>
<th>ADG</th>
<th>MJ DE</th>
<th>g/day</th>
<th>g/day</th>
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</tr>
</thead>
<tbody>
<tr>
<td>6.7</td>
<td>200</td>
<td>5.6</td>
<td>384</td>
<td>359</td>
<td>338</td>
<td>318</td>
</tr>
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<td>7.4</td>
<td>225</td>
<td>6.3</td>
<td>432</td>
<td>404</td>
<td>380</td>
<td>358</td>
</tr>
<tr>
<td>8.0</td>
<td>250</td>
<td>7.0</td>
<td>480</td>
<td>449</td>
<td>422</td>
<td>398</td>
</tr>
<tr>
<td>8.7</td>
<td>275</td>
<td>7.7</td>
<td>528</td>
<td>494</td>
<td>464</td>
<td>438</td>
</tr>
<tr>
<td>9.3</td>
<td>300</td>
<td>8.4</td>
<td>576</td>
<td>539</td>
<td>506</td>
<td>478</td>
</tr>
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With starter diet of 16.5 MJ DE/kg - pigs weaned at 8kg would need to consume 422 g/day to match pre-weaning energy intakes from milk.

Feed intake required/pig ↓ when energy density of the diet is ↑

Target increased energy intake early post-weaning.
9. Summary

- Larger litters: lighter and more variable birth/weaning weights

- Intake and growth challenge immediately post-weaning

- To overcome post-weaning “growth check”
  - Target pre-weaning intakes of feed and water
  - Target increased piglet birth weight (OPTIPIG project)

- Post-weaning diets must contain milk by-products esp LACTOSE

- Cooked cereals unnecessary in early diets but cereals should be clean
9. Summary

- Acids, prebiotics, probiotics - alternatives to antibiotics/ZnO but response not predictable
- Good quality starter and link diets necessary for weaned pigs
- But....levels used should be geared towards pig weaning weight, health and optimization of lifetime growth
- Liquid feeding did not ↑ growth rate but ↑ feed wastage
- Feeding milk replacer for short period after weaning can greatly ↑ piglet growth and gut health
- Intake in first few days after weaning is the Key!
Short Answer

Intake in first few days after weaning is the Key!
7. Liquid Feeding

- Stimulates post-weaning feed intake and growth rate?
- Not in 4 Moorepark experiments
- Wasteful - unacceptable feed efficiency
- Uncontrolled fermentation – growth of pathogens, yeasts & molds

Effect of liquid feeding weaned pigs

<table>
<thead>
<tr>
<th></th>
<th>Plated</th>
<th>Acidified Liquid</th>
<th>Fermented Liquid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning wt (kg)</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Day 27 weight (kg)</td>
<td>17.7</td>
<td>18.5</td>
<td>17.3</td>
</tr>
<tr>
<td>Slaughter weight (kg)</td>
<td>101</td>
<td>99.8</td>
<td>98.4</td>
</tr>
</tbody>
</table>

Lawlor et al. 2002b
Toolbox

Hygiene
Biosecurity
Vaccination programme
Reduced crude protein diets
Weaning Age
Weaning weight
Earlier and increased water intake
Earlier and increased feed intake
Reduce stressors post weaning (environmental, social and nutritional)
Alternative feed additives (Acids, Probiotics, Prebiotics, Phytogenics & Others)
Promote increased and earlier water and feed intake after weaning
Feed intake to match pre-weaning energy intake

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<td>Weaning age</td>
<td>26 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth weight</td>
<td>1.5 kg</td>
<td></td>
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Feed Additives

Alternatives to zinc oxide and antibiotics
8. Reduce Stressors at weaning

- Pigs are less prone to disease if they are not stressed.
  - Feed
  - Water
  - Floor space and Feeder space
  - Heavy and uniform weaning weights
  - Mixing, moving
  - Controlled Environment
  - Stockmanship
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