Maintaining growth in pigs weaned from large litters

Peadar Lawlor, Shane Brady & Seamas Clarke
Introduction

- Weaning - most stressful period in pig’s life
- Post-weaning ‘growth check’
- Always challenged to maintain pre-weaning growths
- 1.7 more live born pigs per litter now than 10 yrs ago
- Large litters = lighter piglets born/weaned and more variable litters
- Challenge now even greater
- Payoff -↓mortality, ↑lifetime growth and ↓days to slaughter
- What have we have learned?
Short Answer

Intake in first few days after weaning is the Key!
1. Weaning Age

- Early weaning ↑sow productivity
  but with ↑health/mortality problems and ↑ feed costs
- 1 day ↑ in weaning age = 500 g 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>
</tbody>
</table>

Lawlor et al., 2003a; Leliveld et al., 2013
2. Wean heavy but “birth weight is king!”

- High intake in first week after weaning = high lifetime growth
- KEY: wean heavier pigs
- **But does it matter how they are heavier?**

**Pre-wean management - pig weight (kg)**

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaning</td>
<td>8.0</td>
<td>8.5</td>
</tr>
<tr>
<td>Day 27</td>
<td>20.3</td>
<td>20.7</td>
</tr>
<tr>
<td>Day 129</td>
<td>96.2</td>
<td>95.1</td>
</tr>
</tbody>
</table>

**Birth weight and pig weight (kg)**

<table>
<thead>
<tr>
<th></th>
<th>Heavy</th>
<th>Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth</td>
<td>1.55</td>
<td>1.38</td>
</tr>
<tr>
<td>Weaning</td>
<td>7.1</td>
<td>5.9</td>
</tr>
<tr>
<td>Day 26</td>
<td>17.5</td>
<td>15.3</td>
</tr>
</tbody>
</table>

- Pre-weaning management cannot correct for low birth weight
- Importance of birth weight - muscle fibre number
- **But must feed a nutrient-dense diet post-weaning to see the benefits**

Lawlor et al., 2002a
3. Water intake

- More than a week after weaning to restore daily fluid intake
  - Suckling pig: ~680ml BUT....
  - 1\textsuperscript{st} day post-weaning: ~290ml
  - 1\textsuperscript{st} week post-weaning: ~442ml
  - 2\textsuperscript{nd} week post-weaning: ~770ml/pig
- Restricted water flow: ↓feed intake and ADG by 15 %
- Supplementary drinkers
- Drinker position critical: height, angle & position
- Bowl drinkers waste 30 % less water and easier for pigs to find water
- Use same type also in the farrowing house
4. Push energy intake early post-weaning

- Daily gain in 1\textsuperscript{st} week post-weaning positively influences pig weight later
- Particularly for light weaned pigs
- Post-weaning growth rate variation is huge:
  - between-farm: 34 \%
  - within-farm: 165 \%
- Most due to differences in feed intake
- Intakes in 1\textsuperscript{st} 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 digestion

Lawlor, 2000; Lawlor et al., 2002
**Feed intake to match pre-weaning energy intake**

<table>
<thead>
<tr>
<th>DE of Diet</th>
<th>15.5</th>
<th>16.5</th>
<th>17.5</th>
</tr>
</thead>
<tbody>
<tr>
<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>
<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>
<th>g/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7</td>
<td>200</td>
<td>5.6</td>
<td>359</td>
<td>338</td>
<td>318</td>
</tr>
<tr>
<td>7.4</td>
<td>225</td>
<td>6.3</td>
<td>404</td>
<td>380</td>
<td>358</td>
</tr>
<tr>
<td><strong>8.0</strong></td>
<td>250</td>
<td>7.0</td>
<td><strong>422</strong></td>
<td>398</td>
<td></td>
</tr>
<tr>
<td>8.7</td>
<td>275</td>
<td>7.7</td>
<td>494</td>
<td>464</td>
<td>438</td>
</tr>
<tr>
<td>9.3</td>
<td>300</td>
<td>8.4</td>
<td>539</td>
<td>506</td>
<td>478</td>
</tr>
</tbody>
</table>

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.
6. 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>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>
</tr>
<tr>
<td>Mortality (%)</td>
<td>10</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Weaning to 10 weeks of age**

<table>
<thead>
<tr>
<th></th>
<th>416</th>
<th>411</th>
<th>432</th>
<th>395</th>
<th>14.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Gain (g)</td>
<td>620</td>
<td>610</td>
<td>653</td>
<td>596</td>
<td>21.8</td>
</tr>
<tr>
<td>Daily Feed Intake (g)</td>
<td>1.51</td>
<td>1.52</td>
<td>1.52</td>
<td>1.52</td>
<td>0.038</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
8. 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 vs. suckled pigs or pigs weaned onto starter diet
- Low post-weaning intakes responsible for ↓ villous height normally seen
- Worsens low growth rate normally seen at weaning
- **It's all about intake in the first few days!**

Pluske et al., 1995; Zijlstra et al., 1996
9. Summary

- To overcome post-weaning “growth check”, target increases in
  - feed and water intake
  - birth weight (OPTIPIG project)
- 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
- 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!
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
5. Post-weaning diet

Diet Acidification

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

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

<table>
<thead>
<tr>
<th></th>
<th>Fumaric acid (%) 0</th>
<th>Fumaric acid (%) 2</th>
</tr>
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<tbody>
<tr>
<td>Intake week 1 (g/day)</td>
<td>187</td>
<td>247</td>
</tr>
<tr>
<td>Intake 0-3 weeks (g/day)</td>
<td>466</td>
<td>518</td>
</tr>
<tr>
<td>Daily gain 0-3 weeks (g/day)</td>
<td>281</td>
<td>339</td>
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*** Acid binding capacity

- Alternative approach
- Diet formulation
- Use ABC values for ingredients
- Ingredients differ in ABC
- Similar effect

Lawlor et al., 2005a; 2005b; 2006
5. Probiotics/Prebiotics

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>
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<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>
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<td>ADFI (g/d)</td>
<td>471</td>
<td>458</td>
<td>475</td>
<td>NS</td>
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<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>
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- **Probiotics**: ‘Live microorganisms – adequate amounts - health benefit’
- Alternative to antibiotics? - 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 medication
- LIVE-5 - ↓ incidence & duration of scouring & ↑ growth in *Salmonella* challenge
- **Prebiotics** pass through upper gut & provide substrate for beneficial bacteria

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

![Graph showing the effect of liquid feeding on weaned pigs.]{:alt="Graph showing the effect of liquid feeding on weaned pigs.拍摄日期: 2022年6月2日 11:36:51"}

Lawlor et al. 2002b
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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 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!