Effect of salmon oil and vitamin D in sow gestation diets on piglet vitality at birth and viability to weaning

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Introduction

- Additional fats are often used to increase energy density

- Soybean oil high conc. of n-6 FA e.g. Linoleic acid (LA)
  - Improve milk yield in sows resulted in an increase in piglet body weight (Lee et al, 2014; Cordero et al, 2011)
  - Improve immune capacity of piglets (Corino et al, 2009)

- Salmon oil high conc. of n-3 FA e.g. Docosahexanoic acid (DHA)
  - Increase piglet vitality at birth
  - Improve growth of nursing piglets
  - Increase n-3 serum conc. in sow and piglet immune cells (Rooke et al, 2001)
Introduction

- Vitamin D₃ (Cholecalciferol) is commonly added to pig diets
- Calcium homeostasis
- Bone health
- Innate and adaptive immunity

- Recommended inclusion rate for gestating and lactating sows is 800 IU/kg (NRC, 2012)
- Up to 2000 IU/kg frequently added to pig diets on Irish farms

- Previously shown to:
  - Increase milk, sow and piglet vitamin D levels (Flohr, et al 2014)
  - Prolong immune responses (Hines, et al 2013)
  - Improve bone strength, mineral content and density (Witschi, et al 2011)
Aim of study

Investigate the use of salmon oil as well as the inclusion rate of vitamin D in sow gestation diets, as a solution to improve piglet vitality at birth and viability to weaning
Materials & Methods

• 120 multiparous sows
• 2x2 factorial design
• Blocked by parity, c.s and weight on day 28

Prior to trial period
• 2.5 kg/day of control from service to day 29 of gestation

Experimental feeding
• Experimental diets were fed from day 30 of gestation until farrowing
• Sows were offered their respective experimental diet at 2.5kg/day to day 79 of gestation and 3.0kg/day from day 80 until parturition
Materials & Methods

Table 1. Oil source and vitamin D content in sow gestation diets

<table>
<thead>
<tr>
<th>Diet</th>
<th>n</th>
<th>Oil source</th>
<th>% Oil inclusion</th>
<th>Vitamin D₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>Soya</td>
<td>2.5</td>
<td>2000</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>Soya</td>
<td>2.5</td>
<td>800</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>Fish</td>
<td>2.5</td>
<td>2000</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>Fish</td>
<td>2.5</td>
<td>800</td>
</tr>
</tbody>
</table>

Diets were cereal soya based (DE 12.9 MJ/kg, CP 14%, Fibre 7.67% and Lysine 0.7%)
Materials & Methods

All sows
- Live-weight, back-fat depth, c.s and locomotion score
- Day 28, 107 and weaning

Blood samples (n=80)
- FAMEs and Vitamin D
- Day 28, 107 and weaning

- All sows were allowed to farrow naturally
- Performance measure e.g. TB, BA, BD etc
  - Birth attended piglets were used for vitality scoring
  - Birth unattended milk and tissue samples were collected
**Materials & Methods**

**Vitality score** (Baxter et al, 2008)
- First 15 secs after birth piglets were scored between 0-3:
  - 0 no movement or breathing
  - 3 good movement, attempts to stand and breathing

**Blood lactate** (Herpin et al, 1996)
- Measure of hypoxia
- Blood lactate meter (artic medical)

**Ponderal index & BMI**
(Baxter et al, 2008)
- Crown to rump
- Abdominal circumference

**IUGR score** (Hales et al, 2013)
- Impact on colostrum intake and survivability
Materials & Methods

Milk & dissection
n=40

Piglet samples
- Piglet of mean birth weight euthanised
- Blood samples (FAMEs, Vit D and Immune cells)
- Tissues (FAMEs and Vit D)
- Hind legs (Bone mineral content and strength)

Milk samples
- Colostrum sample
- Milk sample at day 14 (FAMEs, Vit D, Immune cells)
Materials & Methods

- Data was analysed using Genstat (release 18.1)

- REML linear mixed model
  - Vitality score
  - Sow and piglet weight

- Generalised linear mixed model
  - TB, BA, BD etc
  - Locomotion score
Preliminary results
Interaction between oil source and vitamin D level

<table>
<thead>
<tr>
<th>Variable</th>
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</tr>
<tr>
<td>Gestation length (days)</td>
<td>116.2</td>
<td>117.0</td>
<td>117.0</td>
<td>116.6</td>
<td>0.28</td>
<td>*</td>
</tr>
<tr>
<td>Lactation length (days)</td>
<td>26.5</td>
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<td>25.5</td>
<td>0.25</td>
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<tr>
<td>Lactation intake (kg)</td>
<td>175.1</td>
<td>158.4</td>
<td>153.3</td>
<td>156.5</td>
<td>4.11</td>
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<tr>
<td>24hr weight (all)</td>
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<td>1.40</td>
<td>0.031</td>
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<td>24hr weight (v)</td>
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P<0.05* P<0.01** P<0.001***
### Interaction between oil source and vitamin D level

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<td>0.123</td>
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<td>Ponderal index</td>
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<tr>
<td></td>
<td>2000 IU</td>
<td>800 IU</td>
<td>SEM</td>
<td>Sig</td>
</tr>
<tr>
<td>Live-weight weaning (kg)</td>
<td>265.4</td>
<td>256.2</td>
<td>1.12</td>
<td>***</td>
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9.2 kg
%Probability of piglets born to soya and fish oil sows having vitality score between 0-3

P<0.001***

[Graph showing the % probability of piglets born to soya and fish oil sows having vitality score between 0-3]
Discussion

• DHA essential for cognitive and visual development of fetus

• In previous trials n-6 FA were found in high conc. in colostrum and milk samples

• Ponderal Index and BMI indicators of survivability greatest for piglet born to soya oil sows- inc. no. weaned

• Interactions between oil and vitamin D
  - Sow -soya 2000 & fish 800
  - Piglet -soya 800 & fish 2000
Conclusion

• Preliminary results

• Blood, milk, tissue and bone analysis

• Salmon oil improved piglet vitality immediately at birth

• Soya oil improved piglet growth to weaning
Acknowledgements

Funding
- Department of Agriculture, Food and the Marine (Ireland)
- University of Leeds

Supervisors
- AFBI
- Teagasc
- University of Leeds
Thank you for listening