Exploring the effect of dietary L-carnitine inclusion on the performance of modern hyper prolific sows and their offspring

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Introduction

Irish swine sector (Teagasc eProfit Monitor, 2017)

Pigs born/litter

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>11.5</td>
</tr>
<tr>
<td>2017</td>
<td>13.5</td>
</tr>
</tbody>
</table>

Pigs sold/sow/year (Interpig, 2017)

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of pigs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>28.5</td>
</tr>
<tr>
<td>Netherlands</td>
<td>27.8</td>
</tr>
<tr>
<td>Ireland</td>
<td>27.0</td>
</tr>
<tr>
<td>France</td>
<td>25.7</td>
</tr>
</tbody>
</table>
Introduction

Litter size does have consequences..

Sows
1. High milk demand (LeDividich, 2007)
2. Loss of body reserves (Rutherford et al., 2013)

Offspring
1. Low birthweight (Quiniou et al., 2002)
2. Poor viability (Herpin et al., 1996)
3. Increased litter variation (Quiniou et al., 2002)
4. Increased mortality (Stanton & Carroll, 1974; Lund et al., 2002)
L-Carnitine

AA: Lysine  and methionine

Primary role: Regulate transport of fatty acids

✓ Improved sow energy status  (Borum et al., 1991; Owen et al., 2001; Birkenfeld et al., 2006)

✓ Enhance IGF-1 levels in the sow  (Musser et al., 1999; Owen et al., 2001)

✓ ↑ Nutritional quality of milk  (Ramanau et al., 2004, Ramanau et al., 2005)
L-Carnitine

AA: Lysine and methionine

✓ Regulate transport of fatty acids across (Birkenfield et al., 2006)

✓ Improved sow energy status (Borum et al., 1991, Owen et al., 2001; Birkenfeld et al., 2006)

✓ ↑ Milk nutritional quality (Ramanau et al., 2004, Ramanau et al., 2005)

✓ ↑ Litter size at birth (Musser et al., 1999, Ramanau et al., 2002, Ramanau et al., 2008)

✓ ↑ Birthweight → ↑ muscle fibre number & size (Waylan et al., 2005, Reid et al., 2016)
Objective

L-carnitine supplementation during gestation and/or lactation

• **Sow**
  ↓ Mobilisation of reserves

• **Offspring**
  ↑ Numbers born
  ↑ Lean growth potential
  ↑ Growth & feed efficiency
Materials & Methods
Materials & methods

- 66 sows (~17/treatment)
- Duration: Day 1 of gestation → Day 26 of lactation
- Treatments:
  1. Control (0mg/d)
  2. Gestation (125mg L-carnitine/d during gestation)
  3. Lactation (125mg L-carnitine/d during lactation)
  4. Both (125mg L-carnitine/d during gestation & lactation)
Materials & methods

- Sub-sample followed to slaughter → FIRE feeders
- Treatments:
  1. Control (0mg/d)
  2. Gestation (125mg L-carnitine/d during gestation)
  3. Lactation (125mg L-carnitine/d during lactation)
  4. Both (125mg L-carnitine/d during gestation & lactation)
Materials & methods

• Muscle sampling → Semitendinosus muscle

Birth

Weaning

Sample size at each sampling:
48 → 24M & 24F
96 pigs

• Measures:
  1. Weight
  2. Length
  3. Girth
  4. Fibre typing
Results
Sow Performance
Loss of maternal body reserves

Sow Weight Loss

D108 to Weaning

Control  Gestation  Lactation  Both

kg

P=0.07

Sow Back fat Loss

D108 to Weaning

Control  Gestation  Lactation  Both

mm

P=0.04
Main effects: Sow weight

160  175  190  205  220

D71  D108  Weaning

0mg/day  125mg/day

0mg/day  125mg/day

Gestation

Lactation
Main effects: Sow back fat depth

- **Gestation feeding**
  - D71
  - D108
  - Weaning

- **Lactation feeding**
  - D71
  - D108
  - Weaning
Pre-weaning Performance
Main effects: Birth data

**Numbers born**

- **Total**: 18 (0mg/day) and 20 (125mg/day), +1.6
- **Alive**: 16 (0mg/day) and 17 (125mg/day), +0.9

**Piglet birthweight**

- **Total**: 1.45 kg (0mg/day) and 1.50 kg (125mg/day), +0.5
- **Alive**: 1.30 kg (0mg/day) and 1.35 kg (125mg/day), +0.5

**P-values**:
- Numbers born: P < 0.05
- Piglet birthweight: P = 0.1
Main effects: Piglet weight

**Gestation**

- 0mg/day
- 125mg/day

**Lactation**

- 0mg/day
- 125mg/day

*P = 0.06*
Main effects: Piglet ADG

**Gestation**

- **D0-D1**
- **D1-D14**
- **D14-D26**

**Lactation**

- **D0-D1**
- **D1-D14**
- **D14-D26**

- P = 0.08
• No effect of L-carnitine during Gestation
Muscle Data

- No effect of L-carnitine during Lactation
- L-carnitine → ↑ Glucose

**Muscle weight**
- 0mg/day
- 125mg/day

**Weight length**
- 0mg/day
- 125mg/day

**Muscle girth**
- 0mg/day
- 125mg/day

**Piglet glucose**
- 0mg/day
- 125mg/day

P=0.08
Weaner Performance
# Pig Weight (Days 7-49pw)

- L-carnitine during lactation → Heaviest pigs
- L-carnitine during gestation & lactation → Lightest pigs

<table>
<thead>
<tr>
<th>kg</th>
<th>Treatment</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gestation (mg/d):</td>
<td>Lactation (mg/d):</td>
</tr>
<tr>
<td>D7</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>D14</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>D28</td>
<td>125</td>
<td>0</td>
</tr>
<tr>
<td>D49</td>
<td>125</td>
<td>0</td>
</tr>
</tbody>
</table>
Main effects: Growth (Days 14-49pw)

- No effect of L-carnitine → ADFI & FCR

![Graph showing ADG for Gestation and Lactation stages](image)
Finisher Performance
Main effects (Days 49 – 119pw)

- L-carnitine during gestation → ↓ Slaughter weight
  → ↓ ADFI
  → Improved FCR

| Measure     | Gestation 0mg/d | Gestation 125mg/d | Lactation 0mg/d | Lactation 125mg/d | SEM | SEM | P-value  \
|-------------|-----------------|-------------------|-----------------|-------------------|-----|-----|----------
| D119, kg    | 114.84          | 111.68            | 112.71          | 113.81            | 0.84| 0.84| <0.01   |
| ADG, g/d    | 1134.79         | 1121.84           | 1119.33         | 1137.31           | 11.24| 11.24| 0.39    |
| ADFI, g/d   | 2372.08         | 2259.60           | 2300.13         | 2331.55           | 28.08| 28.07| <0.01   |
| FCR, g/g    | 2.09            | 2.01              | 2.05            | 2.05              | 0.02| 0.02| <0.05   |

P-values indicate statistical significance.
L-carnitine during Gestation → Reduced weight, fat depth & kill out % → Increased lean meat %

**Carcass Data (~Day 119pw)**

- Carcass weight
  - 0mg/day: 88 kg
  - 125mg/day: 82 kg
  - P<0.01

- Fat depth
  - 0mg/day: 14 mm
  - 125mg/day: 12 mm
  - P<0.05

- Kill out
  - 0mg/day: 75%
  - 125mg/day: 72%
  - P<0.05

- Lean meat
  - 0mg/day: 58%
  - 125mg/day: 56%
  - P<0.05
Take home message and Discussion
Supplementing sows with L-carnitine

During gestation
- ↑ Total born
- ↑ Lean meat %
- ↓ ADG & ADFI
- ↓ Slaughter weight

During lactation
- ↑ Piglet glucose
- ↑ Pig weight

Combination
- ↓ Pig weight
Discussion

• Unexpected results..

• Consistent with previous work
  → (-) Impact of L-carnitine
  → Increased lean meat %
Thank you for your attention

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