The Interaction Between Pig Density and Dietary Energy on Performance and Returns

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SUMMARY
Dietary net energy and stocking density independently affect performance, feed utilization and profits in the finisher barn. The objective of this experiment was to assess the interactions of stocking density and dietary energy, and determine how these interactions affect net income. When stocking density was increased, the performance of finishing pigs was reduced; however the income over feed cost (IOFC) was maximized when pigs were stocked at higher densities. Furthermore, finishing pigs responded to increasing dietary energy by decreasing feed intake and improving growth rate, feed efficiency, caloric intake, caloric efficiency, and IOFC. However, the dietary energy which maximized performance and economics did not vary with stocking density. Thus producers should optimize both of these factors separately when determining optimal production.

INTRODUCTION
Stocking density and dietary net energy concentration independently affect performance and feed utilization of growing finishing pigs. There is limited information however, on whether the interaction of these two factors is important for optimizing performance and income. This information is vital to producers facing new requirements for the Canadian Code of Practice on stocking density.

Reduced space allowance has negative effects on growth, and is usually a consequence of reduced nutrient intake. We hypothesized that the negative effects of crowding can be reduced by increasing dietary energy concentration, and that the optimal dietary energy concentration which maximizes net income will depend on stocking density. Pork producers will be able to improve their return on investment by better understanding the relationship between dietary energy and stocking density.

EXPERIMENTAL PROCEDURE
There was a total of 18 treatments arranged as a 2 x 3 x 3 factorial, which included gender (barrows and gilts), dietary energy (2.15, 2.3 and 2.45 Mcal NE/kg) and stocking density (14, 17 or 20 pigs/pen providing 0.92, 0.76 and 0.65 m² per pig, respectively). Each of the 18 treatments had three replications, using a total of 918 pigs (Camborough Plus dam x line 337 sire PIC Canada Ltd.; Winnipeg, MB).

Rooms were fully slatted, and consisted of 10 rectangular (4.8 x 2.7m) pens. Each pen contained two single space wet-dry feeders providing 0.22 m² of feeder space per pen, and the feeders were the only source of water.

"Overall there were no interactions between dietary energy concentration and stocking density."

Pigs were selected to ensure typical barn variation and were started on test at an average of 75 kg BW (range of 60 to 90 kg BW). They were marketed weekly when they reached a BW of 115 kg.

The diets used for this experiment are presented in Table 1. Four sets of diets, with three dietary energy levels within each diet, were used. Diet sets 1 through 3 were fed as the three phases for gilts and diets 2 through 4 were used as the 3 phases for barrows. All diets were formulated to meet or exceed nutrient requirements (NRC, 2012). Feed was available ad libitum but weighed daily when added to the feeder.

Space allowance was calculated by using an allometric equation $k = \frac{A}{BW^{0.667}}$, where "A" represents area (m²), $k$ is a space allowance coefficient, and $BW^{0.667}$ is the metabolic body weight. The $k$-value of 0.0336 was used to define crowding (Table 2) which occurred at about 85 and 108 kg BW with 20 and 17 pigs per pen respectively.
Figure 1 shows the interaction effects on IOFC. Stocking density of 20 pigs per pen and feeding the 2.30 NE, Mcal/kg resulted in the highest IOFC. However, this increase in IOFC was only $70 (CDN) higher per pen than the pigs fed the high energy diet. Pigs housed 20 per pen and fed the low energy diet had an IOFC that was $700.00 lower per pen than the pigs fed the high energy diet. In the pens that housed 17 pigs, IOFC of the high energy diet was $472.00 and $319.00 more than the pens fed the low and medium energy diets, respectively. Increasing dietary energy for pigs housed 14 per pen resulted in no IOFC improvement; all pens had an IOFC within $40.00 of each other.
CONCLUSION

As space allowance decreased, a linear reduction in caloric intake and growth was observed. The restriction in nutrient intake resulted in the growth reduction, suggesting that if pigs were able to maintain a comparable caloric intake at higher stocking densities effects on growth would be reduced. Overall there were no interactions between dietary energy concentration and stocking density. A similar response to dietary energy at all stocking densities was observed. The negative effects of a high stocking density on performance were not mitigated by dietary energy. Increasing the stocking density linearly increased the IOFC per pen but there was not an interaction between dietary energy and stocking density. Therefore the dietary energy which maximized the IOFC did not differ with stocking density.

ACKNOWLEDGEMENTS

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### Table 4. Main effects dietary energy concentration and pen density on barn throughput, carcass revenue, feed cost, and IOFC ¹,²,³

<table>
<thead>
<tr>
<th>Item</th>
<th>Stocking density</th>
<th></th>
<th>Diet regimes</th>
<th>P-value¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocking density</td>
<td>14</td>
<td>17</td>
<td>20</td>
<td>SEM</td>
</tr>
<tr>
<td>Days to market⁴</td>
<td>35.4⁵</td>
<td>36.0⁶,⁷</td>
<td>37.0⁸</td>
<td>0.03</td>
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<tr>
<td>Finisher rotations⁵</td>
<td>3.47⁹</td>
<td>3.45⁶,⁷</td>
<td>3.41⁸</td>
<td>0.05</td>
</tr>
<tr>
<td>Barn throughput⁹</td>
<td>48.5⁹</td>
<td>58.6³</td>
<td>68.3¹</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Carcass revenue/pig⁴</td>
<td>134.33</td>
<td>135.36</td>
<td>133.08</td>
<td>0.02</td>
</tr>
<tr>
<td>Feed cost/pig, CDN $⁴</td>
<td>30.66</td>
<td>30.91</td>
<td>30.71</td>
<td>0.08</td>
</tr>
<tr>
<td>Feed cost per kg gained, CDN $⁵,¹²</td>
<td>0.73</td>
<td>0.72</td>
<td>0.72</td>
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<td>Feed cost pig/d, CDN $⁹,¹³</td>
<td>0.87⁴</td>
<td>0.86⁴,⁷</td>
<td>0.83⁸</td>
<td>&lt;0.001</td>
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<td>Feed cost/pen, CDN $⁴</td>
<td>429.48³</td>
<td>525.49⁴</td>
<td>614.14¹</td>
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<td>Carcass margin/pig CDN $</td>
<td>103.40</td>
<td>104.19</td>
<td>102.89</td>
<td>0.78</td>
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<td>IOFC CDN $⁵,¹²</td>
<td>5,012.50</td>
<td>6,102.50</td>
<td>7,015.90</td>
<td>0.22</td>
</tr>
</tbody>
</table>

abc Within a row and treatment, means without a common superscript differ (p<0.05)

¹Dietary energy x stocking density (P > 0.10)

²Feed prices based on Saskatoon, SK 5 year average grain prices (2009-2013)

³P-values stocking= stocking density, NE= dietary net energy

⁴Days to market from 75-118 kg BW

⁵Finisher rotations = 365/(days to market + (70 day constant for all treatments 20-75 kg BW))

⁶Barn throughput = finisher rotations x pigs per/pen

⁷Value calculated from 75- market wt.

⁸Carcass revenue based on a 5 year average Saskatchewan carcass price (2009-2013)

⁹Feed cost per/kg gained = F:G x cost per tonne

¹⁰Feed cost per pig/d = ADFI x cost per tonne

¹¹IOFC = annual income over feed cost based on carcass value and barn throughput (75-118 kg BW)

¹²Gender x Energy (P < 0.10)

¹³Gender x Energy (P < 0.05)