Performance and Carcass Quality of Growing-Finishing Pigs Submitted to Reduced Nocturnal Temperature

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Executive Summary

During summer months, elevated barn temperature reduces pig growth rate by decreasing feed intake. A pilot study followed by a large scale experiment were conducted over two summers to evaluate the impact of reduced nocturnal temperature on the performance and carcass quality of growing-finishing pigs over summer months. Typical rooms had a typical temperature setpoint while the temperature setpoint for treatment rooms was 6°C lower. In Saskatchewan, a reduced temperature setpoint (RNT) resulted in a lower nocturnal room temperature (1.6°C cooler over eight weeks), while it had no influence on daytime room temperature. The average daily temperature fluctuation in treatment rooms was increased by 2.1°C. During the pilot study, pig average daily gain (ADG) in the RNT room was increased by 5.2%. For the large scale experiment, feed intake was 3.2% higher in RNT rooms which increased ADG by 2.1% in average over eight weeks. The ADG increase averaged 3.6% during the last four weeks of the large scale experiment. However, pig performance was not statistically increased by the RNT (P>0.05) and no statistical difference was found in terms of feed conversion and back fat thickness (P>0.05). Even without statistical significance, the RNT setpoint strategy would provide a net return of 0.80 CAN$/pig sold for pigs raised over the summer period in Saskatchewan. The results suggest that healthy pigs are not negatively affected by a large daily temperature fluctuation (up to 13°C) as long as this fluctuation is progressively achieved. Based on this research, it is also suggested that temperature setpoints for the summer period for growing-finishing pigs should not be increased to reduce daily temperature fluctuations.

Introduction

During summer months, elevated barn temperature reduces the animal growth rate by decreasing the feed intake (Nienaber et al. 1987; Lopez et al. 1991; Nienaber et al. 1997). This negative impact on pig performance lengthens the growth period and reduces the productivity level of a swine barn. Experiments showed that when ambient temperature raises from 20 to 30°C, the rate of gain is reduced by 17.6 to 40.0 g/d· ºC (Lopez et al. 1991; Nichols et al. 1982; Nienaber et al. 1987; Massabie et al. 1997).

The thermal comfort zone of the pig depends on many environmental factors. For growing pigs (25 to 60 kg) on solid floor, the temperature should be maintained between 15 to 24°C (McFarlane and Cunningham 1993; Zhang 1994). When pigs are between 60 to 100 kg, the recommended temperature setpoints vary from 14 to 21°C (Midwest Plan Service 1983; McFarlane and Cunningham 1993; Zhang 1994). Since fluctuating environment in confined facilities is believed to be detrimental to pigs, it is generally recommended to increase the temperature setpoint during the summer season to reduce temperature fluctuations between day and night (Zhang 1994). Typical summer setpoint recommendations would be 22°C for 25 kg pigs with a gradual reduction to 16°C when pigs reach 75 kg.

In the Canadian Prairies, summer days can be very hot but nights are generally cool. Based on previous experiment results, it was suggested that a reduced temperature setpoint during the
summer could sustain the pig performance by perhaps modifying pig eating behavior and stimulating the average daily feed intake.

The objective of that research was to evaluate the impact of a reduced temperature control strategy during summer nights on growing-finishing pig performance and carcass quality.

Experimental procedures

Two trials, a pilot study and a large scale experiment, were conducted over two summers. Typical rooms had a typical temperature setpoint that is generally used in commercial barns while the temperature setpoint for reduced nocturnal temperature (RNT) rooms was lowered by 6°C.

The pilot study was realised from July 11\textsuperscript{th} to September 4\textsuperscript{th}, 1997 using a total of 288 pigs. The pigs were allocated in two identical rooms with in each room, six pens of 12 barrows and six pens of gilts that had an initial average bodyweight of 43 kg in each room. For the typical room, the temperature setpoint of 43 kg pigs was initially set at 19.8°C and was reduced at 16°C by the time pigs were 75 kg and kept at that level thereafter. In the RNT room, the temperature setpoint was initially set at 13.9°C for 43 kg pigs and it was reduced at 10°C when pigs were 75 kg and kept at that level thereafter.

For the large scale experiment, six small identical grower-finisher rooms were used where 432 pigs were allocated randomly to fill three pens of 12 barrows and three pens of 12 gilts in each room. The average pig weight in each room was 39 kg at the start of the experiment. The experiment was conducted for eight weeks from July 24\textsuperscript{th} to September 17\textsuperscript{th}, 1998. To complete three replicates simultaneously, a typical control strategy was implemented in three rooms while the three other rooms were under a RNT strategy. For typical rooms, the temperature setpoint was initially set at 22.3°C for 39 kg pigs and then decreased to 18°C by the time the pigs were 75 kg and kept at that level for the rest of the experiment. In RNT rooms, the temperature setpoint was initially set at 16.3°C for 39 kg pigs and was reduced to 12°C when the pigs were 75 kg and then kept at that level thereafter.

For both trials, the outside air temperature and relative humidity were measured with an integrated sensor. The air temperature at the air inlet location and in both rooms were measured with type T thermocouple. The room relative humidity was evaluated with bulk polymer humidity sensors. The ventilation rate was calculated from the room static pressure and the rotation speed of each fan measured respectively by pressure transducers and proximity sensors.

The air quality in each room was characterized by the carbon dioxide (CO\textsubscript{2}) and ammonia (NH\textsubscript{3}) concentrations. A peristaltic pump collected room air in a Tedlar bag and mean gas concentrations were evaluated with colorimetric tubes on a weekly basis.

In both trials, pigs were fed the two regular PSCI diets during the growing-finishing period. Pig average daily gain, feed disappearance and feed conversion were calculated for each treatment. Pigs were weighed and the feed was cumulated at the beginning and on every second week. At the end of the pilot scale study, three pigs per pen were scanned with a real time ultra sound for lean percentage measurements. At the end of the large scale experiment, the back fat thickness at the last ribbon loci of four pigs per pen was measured. The treatment effect was evaluated by its impact on pig performance (average daily gain, feed conversion) and carcass quality (lean percentage and back fat thickness).
The Results

In Saskatchewan, a RNT strategy resulted in a lower nocturnal room temperature (1.6°C cooler at night over eight weeks), while no influence on room daytime temperature could be measured. The average daily temperature fluctuation in RNT rooms was increased by 2.1°C. The temperature pattern in typical and RNT rooms for three days of experiment is presented on Fig. 1. The RNT also resulted in a higher relative humidity (+3%) and lower carbon dioxide and ammonia concentrations.

During trial 1, pig average daily gain (ADG) in the RNT room was increased by 5.2% as showed in table I. For trial 2, feed intake was 3.2% higher in RNT rooms which increased ADG by 2.1% in average over eight weeks as presented in table II. The ADG increase averaged 3.6% during the last four weeks of trial 2. Daily gains for all pigs in both experiments averaged respectively 0.867 kg/day for typical rooms and 0.899 kg/day for RNT rooms (3.7% increase). For a total weight gain of 87 kg, the RNT strategy would save four days to market for growing-finishing pigs raised over the summer. However, pig performance was not statistically increased by the RNT (P>0.05). No statistical difference was found in terms of feed conversion and back fat thickness (P>0.05).

These results could suggest that growing-finishing pigs raised with a RNT setpoint could be fatter than pigs housed under typical conditions and consequently, those pigs could fall under a different class of the carcass classification system. First of all, the average final weight of monitored pigs in RNT rooms was higher than in control rooms (87.1 vs. 85.4 kg). So, in percentage, the higher back fat thickness is less important than in an absolute value. Secondly, some diet manipulations could be implemented with the reduced nocturnal strategy to maintain the same carcass fat percentage without changing the diet cost and pig performance ratio.

The results from those two experiments challenge the argument saying that growing-finishing pigs should not be submitted to large daily temperature fluctuations and therefore, to reduce daily fluctuations, summer temperature setpoints should be slightly increased. In fact, pigs submitted to a RNT were exposed to a larger daily temperature fluctuation (2°C larger) and grew faster than control pigs. Which leads to the conclusion that healthy pigs can adequately deal with a large temperature fluctuation as long as this fluctuation is progressively achieved. As shown on Fig. 1, the temperature decrease in treatment rooms was achieved over approximately six hours. It was not a drastic decrease in temperature and it was probably the main reason why pigs were able to perform well with such a daily temperature fluctuation. Based on this research, it is suggested that summer temperature setpoints for growing-finishing pigs should not be increased to reduce daily temperature fluctuations.

The cost of raising a growing-finishing pig without feed has been calculated in two different ways and is being estimated at 0.26 CAN$/pig sold-day. Feed cost for growth must be removed from the calculation because pigs are housed longer over the summer but they eat the same amount of feed (same F.C. ratio). The first calculation has been done from maintenance feed costs. Considering that 2576 Kcal D.E./day needs to be provided for maintenance on a daily basis (Maintenance = 110 Kcal D.E./BW10.75, average weight over the period = 67 kg, average feed cost and D.E. contain: 200 CAN$/t, 3100 D.E./kg), daily feed costs for maintenance are 0.17 CAN$/pig-day. Assuming that feed costs represent 65% of total production costs, the cost of maintaining a pig in the barn without feed for growth would be 0.26 CAN$/pig sold-day.

The second cost estimate was established from production costs published by the Ministry of Agriculture, Food and Rural Affairs in Ontario (OMAFRA 1999). In subtracting Farrow-to-25 kg costs from Farrow-to-Finish costs and removing feed costs, housing costs of growing finishing pigs within a Farrow-to-Finish operation end up being 0.25 CAN$/pig sold-day. Therefore, an average housing cost of 0.26 CAN$/pig sold-day seems to be a very good estimation.
The RNT strategy can be implemented without any capital cost considering that only the temperature setpoint needs to be adjusted. The operating cost of the strategy is considered to be the energy requirements of the last ventilation stage running 8 h/day for the whole growing-finishing period. This assumption is very conservative because the difference in ventilation rate between both room types was being seen for less than 8 h/day and not every day. For the large scale experiment, this operating cost would have been 0.24 CAN$/pig sold (Energy cost: 0.06 CAN$/kW•h).

Therefore, based on results from both experiments, the RNT strategy would provide a net return of at least 0.80 CAN$/pig sold for pigs raised over the summer period. Even if no statistical difference in ADG was found, this net return leads us to believe that a RNT strategy is an interesting option to sustain growing-finishing pig performance over the summer in a geographic area with a continental climate.

Conclusion and Implications

The results suggest that even without statistical significance, the RNT strategy would provide a net return of 0.80 CAN$/pig sold for pigs raised over the summer period in Saskatchewan. Both trials showed that healthy growing-finishing pigs are not negatively affected by a large daily temperature fluctuation (up to 13°C) as long as this fluctuation is progressively achieved through the day-night outside temperature fluctuation. Based on this research, it is also suggested that summer temperature setpoints for growing-finishing pigs should not be increased to reduce daily temperature fluctuations.

Acknowledgements

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References


### Table I

Pig performance and carcass quality for the pilot study
(July 11<sup>th</sup> to September 4<sup>th</sup>, 1997)

<table>
<thead>
<tr>
<th>Sex</th>
<th>ADG&lt;sup&gt;*&lt;/sup&gt; (kg/day)</th>
<th>TFI&lt;sup&gt;*&lt;/sup&gt; (kg)</th>
<th>F.C.&lt;sup&gt;*&lt;/sup&gt; (kg/kg)</th>
<th>Carcass lean (RT Ultra sound, %)&lt;sup&gt;†&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical RNT</td>
<td>Typical RNT</td>
<td>Typical RNT</td>
<td>Typical RNT</td>
</tr>
<tr>
<td>Male</td>
<td>0.905</td>
<td>10330</td>
<td>2.950</td>
<td>40.1</td>
</tr>
<tr>
<td></td>
<td>0.953</td>
<td>10753</td>
<td>2.981</td>
<td>39.2</td>
</tr>
<tr>
<td>Female</td>
<td>0.855</td>
<td>9059</td>
<td>2.834</td>
<td>40.7</td>
</tr>
<tr>
<td></td>
<td>0.898</td>
<td>9714</td>
<td>2.771</td>
<td>40.5</td>
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<tr>
<td>Average</td>
<td>0.880</td>
<td>9695</td>
<td>2.892</td>
<td>40.4</td>
</tr>
<tr>
<td></td>
<td>0.926</td>
<td>10234</td>
<td>2.876</td>
<td>39.9</td>
</tr>
</tbody>
</table>

<sup>*</sup>ADG: average daily gain, TFI: total feed intake, F.C.: feed conversion.

<sup>†</sup>RT Ultra sound: real time ultra sound.

### Table II

Pig performance and carcass quality from the large scale experiment
(July 24<sup>th</sup> to September 17<sup>th</sup>, 1998)

<table>
<thead>
<tr>
<th>Sex</th>
<th>ADG&lt;sup&gt;*&lt;/sup&gt; (kg/day)</th>
<th>ADFI&lt;sup&gt;*&lt;/sup&gt; (kg/day)</th>
<th>F.C.&lt;sup&gt;*&lt;/sup&gt; (kg/kg)</th>
<th>BF Thickness&lt;sup&gt;*&lt;/sup&gt; (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical RNT</td>
<td>Typical RNT</td>
<td>Typical RNT</td>
<td>Typical RNT</td>
</tr>
<tr>
<td>Male</td>
<td>0.874</td>
<td>2.301</td>
<td>2.692</td>
<td>11.4†</td>
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<tr>
<td></td>
<td>0.900</td>
<td>2.366</td>
<td>2.682</td>
<td>11.7†</td>
</tr>
<tr>
<td>Female</td>
<td>0.833</td>
<td>2.136</td>
<td>2.628</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td>0.844</td>
<td>2.212</td>
<td>2.668</td>
<td>11.2</td>
</tr>
<tr>
<td>Average</td>
<td>0.854</td>
<td>2.219</td>
<td>2.660</td>
<td>11.0a‡</td>
</tr>
<tr>
<td></td>
<td>0.872</td>
<td>2.289</td>
<td>2.675</td>
<td>11.5a</td>
</tr>
</tbody>
</table>

<sup>*</sup> ADFI: average daily feed intake, BF thickness: back fat thickness.

† Males were statistically different than females (P<0.05)

‡ Averages followed by the same letter on a same row are not statistically different (P>0.05).
Figure 1. Temperature pattern in typical and RNT rooms from September 4th to 7th, 1998.