Effects of sires with different weight gain potentials and varying planes of nutrition on growth of growing-finishing pigs

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Abstract
The present study was performed to investigate the effects of two groups of sires with 'medium' and 'high' weight gain potentials (M-sires and H-sires, respectively) on growth of their progenies on varying planes of nutrition during the growing-finishing period. The ADG of the M-sires' progeny was greater (P < 0.05) than that of the H-sires' progeny (0.51 vs. 0.47 kg) during a 26- to 29-d early grower phase beginning from 55 d of age, but the opposite was true (0.66 vs. 0.72 kg) during the latter grower phase. Overall grower-phase ADG was greatest on the high plane of nutrition (H plane) followed by the medium (M) and low (L) planes (0.65, 0.61, and 0.51 kg, respectively; P < 0.05) in the M-sires' progeny, whereas in the H-sires' progeny, ADG was greater on the H and M planes vs. L plane (0.63, 0.62, and 0.54 kg, respectively). The ADG of pigs on the M or H plane during the grower phase and switched to the H plane thereafter (M-to-H or H-to-H planes) was greater than that of pigs on the L-to-L planes (0.99 vs. 0.78 kg) during the early finisher phase in the M-sires' progeny (P < 0.01). However, in the H-sires' progeny, ADG of pigs on the L-to-L planes did not differ from that of pigs on the M-to-M or H-to-M planes (0.94 vs. 0.96 kg). Results suggest that the H-to-H or H-to-M planes and M-to-M or M-to-L planes are optimal for maximal growth of the M- and H-sires' progenies, respectively.

Keywords: Sire, Progeny, Weight gain, Plane of nutrition, Growing-finishing pig

Background
The rate of weight gain or lean gain is a most important economic trait in pig production [1-3]. Breeding pigs have thus been selected for greater ADG/lean gain and less backfat thickness for decades in the Western countries, partly because most consumers prefer lean pork, partly because lean gain is much more efficient energetically than fat gain [4,5]. Given the genetic background, growth of pigs is determined primarily by nutrition as well as environmental stressors including the presence/absence or severity of diseases and heat stress [6-9].

Backfat thickness, a negative indicator of lean gain, which is known to be moderately correlated with the rate of weight gain [5], decreased through the mid-2000s as a result of selection of breeding pigs for greater lean gain in Korea [10]. However, backfat thickness rebounded by approximately 2 mm during the latter 2000s due primarily to an allegation that lean pigs are less resistant to diseases, especially to the post-weaning multi-systemic wasting syndrome (PMWS) prevalent during that period, and also are less preferred by domestic consumers [11]. This resulted in a comparable increase in the backfat thickness of market pigs with a lag time of approximately 2 years [12]. Currently, the average backfat thickness of market pigs in Korea is 21.3 mm with an average liveweight of 114.5 kg [13]. This is much greater than the estimated 17 mm or less at the same liveweight in the USA [14] where the average liveweight of market pigs was 125.4 kg in 2013 [15]. These data suggest that overall growth potential of growing-finishing pigs in Korea is lower than that in the USA. As an initial step to see the influences of genetic growth potential on growth efficiency and thereby suggesting optimal feeding programs for pigs with different growth potentials, effects of sires with a high weight gain potential vs. a medium potential on growth of their
progenies during the growing-finishing period were investigated in the present study.

Methods

Breeding

Four Duroc boars of JSR Genetics Ltd. (East Yorkshire, UK) origin, which were judged to have a high weight gain potential (H-sires) based on their breeding indices, were purchased from Darby Genetics Inc. (Anseong, Korea) for the present experiment in the fall of 2011. The other four boars with a medium weight gain potential (M-sires), which were suitable as sires under the carcass grading standard of 2011 [16], were selected from boars available in a commercial farm where the present experiment was performed. The H-sires and M-sires were mated to more than 20 Yorkshire × Landrace ‘M-dams’ of JSR origin per sire group by artificial insemination in mid-February, 2012. The progeny used for the present experiment were born on June 7 and received cross-fostering within the litters born to each sire group, iron injection, and other routine cares for suckling pigs during 21 d of lactation.

Experimental animals and diets

Weanling pigs were pooled by sex in each progeny from the respective group of sires, randomly distributed to the nursery pens (34 animals per pen), and fed the 3-phase nursery diets as previously described [17]. At 55 d of age, three pens of females and three pens of castrated males in each of the two progeny groups were selected and moved to grower pens by the pen unit for the present experiment beginning from August 1, 2012. Each pen in each progeny group × sex combination was placed on a high, medium, or low plane of nutrition during the grower phase (Table 1) for 55 to 57 d, after which the pigs were subjected to one or low plane of nutrition during the grower phase (Table 1) for 55 to 57 d, after which the pigs were subjected to one of the two dietary treatments in each progeny group. In the M-sires’ progeny, pigs on the high or medium plane of nutrition during the grower phase were fed the high (H)- and medium (M)-plane finisher diets during the finisher phases 1 and 2 up to marketing, respectively, whereas those on the low (L) plane of nutrition during the grower phase were fed the L-plane finisher diet during both finisher phases 1 and 2 (Table 2). In the progeny of the H-sires, pigs on the H or M plane of nutrition during the grower phase were fed the M- and L-plane finisher diets during the finisher phases 1 and 2, respectively; those on the L plane of nutrition during the grower phase was fed the L-plane finisher diet during both finisher phases 1 and 2.

A total of 120 pigs in 12 pens (10 animals per pen), which had been selected randomly at the outset of the experiment, were weighed at the beginning as well as at the ends of grower phases 1 and 2 and finisher phases 1 and 2. The animals were transported to a local abattoir on the last day of the finisher phase 2 and slaughtered the following day after overnight lairage. Backfat thickness of the carcass was adjusted to a liveweight of 115 kg as described previously [18,19]. The number of days required to reach the 115-kg liveweight was estimated as follows: age in days at the end of the finisher phase 2 + (115 kg - liveweight of the finisher phase 2 in kg)/ADG during the finisher phase 2.

The experimental protocol conformed to the guidelines of the Institutional Animal Care and Use Committee (IACUC) at Gyeongnam National University of Science and Technology. The animals used in the present study were treated humanely throughout the study and did not receive any prolonged constraint.

Statistical analysis

All data were analyzed using SAS (SAS Inst. Inc., Cary, NC, USA). Individual animal was the experimental unit in all analyses. Data for the grower phase were analyzed using the GLM procedure as a completely randomize design with a 2 (sire type) × 2 (sex) × 3 (plane of nutrition) factorial arrangement of treatments. Finisher phase results of the two progeny groups born to their respective sire groups were analyzed separately using the ANOVA procedure for estimation of P-values for the fixed errors and their interactions as well as using the GLM procedure for estimation of the least squares means and comparisons between means by the PDIF option. Effects of the fixed errors and their interactions and differences between two means were considered to be significant when the corresponding P-value was less than 0.05.

Table 1 Declared minimum nutritional values of the commercial diets used in the present study (as-fed basis)

<table>
<thead>
<tr>
<th>Item</th>
<th>Grower phase 1</th>
<th>Grower phase 2</th>
<th>Finisher</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Crude protein, %</td>
<td>18.2</td>
<td>17.5</td>
<td>15.5</td>
</tr>
<tr>
<td>Lysine, %</td>
<td>1.1</td>
<td>1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Crude fat, %</td>
<td>6.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>DE, Mcal/kg</td>
<td>3.45</td>
<td>3.35</td>
<td>3.30</td>
</tr>
</tbody>
</table>

1)–3) Fed from 16–29 kg, 29–48 kg, and 48–114 kg of body weight, respectively, on average.

4)–6) High-, medium, and low planes of nutrition, respectively.

It was informed from the formulator of the experimental diets that actual nutrients densities of the finisher H were higher than those of the finisher M and also comparable to those of the phase 2 grower M.