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Determining the effect of restricted feed intake on developing pigs weighing between 150 and 250 lb, fed two or six times daily (2006)

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DETERMINING THE EFFECT OF RESTRICTED FEED INTAKE ON DEVELOPING PIGS WEIGHING BETWEEN 150 AND 250 LB, FED TWO OR SIX TIMES DAILY

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Summary

Two 42-d studies were conducted to evaluate the effect of restricted feed intake and feeding frequency on the performance of pigs weighing from 150 to 250 lb (initially 148 lb in Exp. 1 and 155 lb in Exp. 2). Our objective was to use the limit-fed finishing pig as a model for gestating sows who are also limit fed. In both experiments, pigs were housed in a 6 ×10 ft pen with half solid cement and half slatted flooring, and with one nipple waterer. The diet consisted of a diet based on corn-soybean meal, formulated to 1.15% TID lysine (1.29% total lysine) and 1,494 kcal of ME/lb. Energy and lysine were supplied to pigs to target an average growth rate of 1.75 lb/d, based on NRC (1998) values. Pigs were fed by dropping similar amounts of feed, either 2 or 6 times per day, by an Accu-Drop Feed Dispenser (AP Systems, Assumption, IL) on the solid cement flooring with *ad libitum* access to water. In Exp. 1, there was an increase ($P<0.01$) in ADG and a decrease ($P<0.02$) in F/G for pigs fed similar amounts of feed 6 times per day, compared with pigs fed 2 times per day. In Exp. 2, increasing the feeding frequency of pigs fed a restricted diet from 2 to 6 times per day improved ADG ($P<0.02$) and F/G ($P<0.03$). These studies indicate that increasing the frequency of feeding may improve the metabolic efficiency of the growing pig fed a restricted diet. More research is needed to determine whether the greater gain is due to improved efficiency or whether there is another reason, such as a decrease in feed wastage.

(Key Words: Feeding Frequency, Restricted Intake, Pigs.)

Introduction

Sow longevity is the primary economic indicator of efficient piglet production. Most sow longevity research concentrates on feed intake and backfat loss during lactation, but little data is available on the effect of gilt performance on longevity. Current development recommendations are that gilts should reach their second estrus at a minimum body weight of 300 lb before they are eligible for breeding; some producers and breeding stock companies desire that gilts also reach a minimum age. In high-health situations, gilts may be past the 300 lb target weight before expressing their second estrus or reaching the minimum age set by the breeding stock supplier. Breeding gilts at too heavy a weight ultimately increases the lifetime feed maintenance requirement. Restricting feed intake in developing gilts would reverse this effect, but restricting feed is extremely difficult due to facility constraints.

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We recently tested whether increasing the frequency of feeding from 2 to 6 times per day for sows in group-housed pens would improve the welfare and/or reduce the variation in weight gain. The feeding regimen was spread out over a 2-h period, with 3 feedings in the morning and afternoon. Results from this trial produced a variable response to increasing feeding frequency in sows, but we decided to test the feeding regimen in developing gilts that were on a higher level of feeding, above maintenance. Furthermore, to our knowledge there are little data presently available that examine the effects of feeding gilts 2 versus 6 times per day.

The objective of this study was to determine if the frequency of feeding a restricted diet to pigs in a group-housed environment had any effect on pig performance or variation of weight gained.

Procedures

General. All experiments were conducted at the Kansas State University Swine Research and Teaching Center. Each pen was 6 × 10 ft and contained half solid and half slatted flooring with a deep pit and one curtain side. Each pen had one nipple waterer to allow *ad libitum* access to water.

Diet. The experimental diet was a corn-soybean meal diet formulated to 1.15% TID lysine (1.29% total lysine) and 1,494 kcal of ME/lb (Table 1). All pigs were fed a restricted diet that was calculated to allow a gain of 1.75 lb/d, based on NRC (1998) values. The amount of feed given to a pen was determined every 14 d, based on combined pen weight. If a pig was removed from the study for any reason, the pig weight and pen feed consumption to date was recorded, and feed drops were adjusted to accommodate changes in the feeding calculation. Feed was measured and delivered by using an Accu-Drop Feed Dispenser (Automated Production Systems, Assumption, IL). Feed was dropped onto the solid concrete portion of the floor.

Table 1. Composition of Diets (As-fed Basis)[a]

Item, %	Diet
Corn	63.14
Soybean meal (46.5%)	33.26
Monocalcium P (21% P, 18% C)	1.40
Limestone	1.25
Salt	0.35
Trace mineral premix	0.20
Vitamin premix	0.15
L-lysine HCl	0.15
L-threonine	0.05
DL-methionine	0.05
Total	100.00
Calculated Analysis	
ME, kcal/lb	1,494
Crude protein, %	21.0
Total lysine, %	1.29
TID amino acids, %	
Lysine, %	1.15
Threonine, %	0.74
Isoleucine, %	0.79
Leucine, %	1.66
Ca, %	0.87
P, %	0.70
Available P, %	0.37

[a]Energy and lysine were supplied to pigs to meet an average growth rate of 1.75 lb/day, based on NRC (1998) values.

Experiment 1. A total of 160 pigs with an initial weight of 148 lb were used in a 42-d growth assay to determine the effects of feeding a restricted diet either 2 or 6 times per day on growth performance. Pigs were separated by sex and blocked by body weight (BW) to 16 pens of 10 pigs each. There were 4 pens of barrows and 4 pens of gilts per treatment, for a total of 8 replications. Pigs were provided their daily feed allotment in 2 or 6 meals. Pigs fed 2 times per day were fed at 07:00 and 15:30 h. Pigs fed 6 times per day were fed at

07:00, 07:30, 08:00, 15:30, 16:00, and 16:30 h. Pigs were weighed individually on d 0, 14, 28, and 42 to determine ADG, F/G, and weight variation (CV).

Experiment 2. A total of 160 pigs (80 barrows and 80 gilts) initially weighing 155 lb were randomly allotted by BW to 16 pens of 10 pigs each. Pigs were separated by sex and given 2 or 6 feedings per day to measure growth performance. Pigs receiving 2 meals were fed at 07:00 and 15:00 h. Pigs fed 6 times per day had a greater interval between meals within the morning and afternoon feedings, with feedings at 07:00, 08:00, 09:00, 15:00, 16:00, and 17:00 h. Pigs were weighed individually every 14 d to determine ADG, F/G, and weight variation.

Statistical Analysis. Data from all experiments were analyzed as a randomized design. Analysis of variance was performed by using the MIXED procedure of SAS.

Results

Experiment 1. For the overall 42-d trial, pigs fed 6 times a day, versus 2 times a day, increased ($P<0.01$) ADG and decreased ($P<0.02$) F/G. The response was due to numeric improvements in all three feeding periods (d 0 to 14, 14 to 28, and 28 to 42). The coefficient of variation was not ($P = 0.82$) influenced by increasing the feeding frequency from 2 to 6 times per day. In addition, ADFI was not affected ($P = 0.91$) because similar amounts of feed were provided to both treatments.

Experiment 2. Over the entire 42-d trial, pigs fed 6 times a day, versus 2 times a day, had improved ADG ($P<0.02$) and F/G ($P<0.03$). Like Exp. 1, the growth performance response was directly related to the increased response seen in all three feeding periods (d 0 to 14, 14 to 28, and 28 to 42). The CV of gain was not influenced ($P = 0.45$) by treatments. Average daily feed intake was not influenced ($P = 0.91$) because the exact same amount of feed was given to both treatments.

Discussion

Increasing feeding frequency from 2 to 6 times per day resulted in a greater response in ADG than expected. The magnitude of the response was especially surprising after finding no benefits in weight gain to increased feeding frequency in gestating sows. The improvement in ADG may have been due to either altered efficiency of metabolism or to a reduction in feed wastage.

Previous research showed that frequent feeding increased the efficiency of utilization of metabolizable energy for production in growing pigs. The efficiency of ME for growth was increased approximately 6% in swine fed 5 times per day versus pigs fed 2 times a day. Other studies have demonstrated that many small meals trigger a greater output of enzymes from the pancreas. The repeated intake of small portions of feed also has been shown to positively influence the digestibility of the feed. Frequent small meals also have been observed to result in a greater lean tissue content of the carcass. Furthermore, it has been reported that growing sheep and cattle increased their utilization of metabolizable energy when fed more frequently, but this response was lost in mature ruminants. The response to more frequent feedings was reversed in the rat, which had a greater efficiency of energy utilization for meal feeding instead of nibbling.

It is also possible that the improvement in ADG was due to a reduction in feed wastage with feeding 6 times per day. When compared with predicted performance from the NRC (1998) model, all pigs gained less than the expected gain of 1.75 lb per day. This would signify that either the pigs were less efficient than the model would suggest, or that feeding larger amounts of feed 2 times a day resulted in more wastage during the 42-d trial than

feeding smaller increments of feed 6 times per day. Because we were not able to examine feed wastage in these trials, a follow-up study to examine changes in feed wastage with multiple feedings is under way.

Table 2. Effect of Feeding Frequency and Energy-restricted Diet on Performance of Finishing Pigs (Exp. 1)[a]

	Frequency of Feeding per Day[b,c]			
Item	2	6	SE	P-value (P <)
d 0 to 14				
ADG, lb	0.98	1.10	0.082	0.16
ADFI, lb	3.42	3.42	0.003	0.99
F/G	3.59	3.19	0.209	0.07
CV of gain, %	5.21	5.06	0.429	0.73
d 14 to 28				
ADG, lb	1.56	1.83	0.082	0.01
ADFI, lb	3.70	3.71	0.003	0.19
F/G	2.39	2.04	0.209	0.10
CV of gain, %	3.99	4.31	0.429	0.46
d 28 to 42				
ADG, lb	1.46	1.58	0.082	0.16
ADFI, lb	3.97	3.96	0.003	0.15
F/G	2.75	2.53	0.209	0.29
CV of gain, %	4.19	4.19	0.429	0.99
d 0 to 42				
ADG, lb	1.37	1.51	0.049	0.01
ADFI, lb	3.70	3.70	0.001	0.91
F/G	2.91	2.59	0.116	0.02
CV of gain, %	4.46	4.52	0.229	0.82

[a]Each value is the mean of 8 replications, with 10 pigs (initially 148 lb) per pen.
[b]Pens that were fed twice daily received feed at 07:00 and 15:30 hours; Pens that were fed 6 times a day received feed at 07:00, 07:30, 08:00, 15:30, 16:00, and 16:30 hours, respectively.
[c]Feed drops were adjusted every 14 d, based on the average weight of pigs.

Table 3. Effect of Feeding Frequency and Energy-restricted Diet on Performance of Finishing Pigs (Exp. 2)[a]

	Frequency of Feeding per Day[b,c]			
Item	2	6	SE	P-value (P <)
d 0 to 14				
ADG, lb	1.06	1.35	0.084	0.02
ADFI, lb	3.48	3.48	0.002	0.75
F/G	3.37	2.76	0.305	0.17
CV of gain, %	5.37	5.09	0.502	0.70
d 14 to 28				
ADG, lb	1.37	1.57	0.084	0.10
ADFI, lb	3.84	3.84	0.002	0.35
F/G	2.83	2.50	0.305	0.45
CV of gain, %	4.38	4.65	0.502	0.71
d 28 to 42				
ADG, lb	0.91	1.19	0.084	0.03
ADFI, lb	4.11	4.11	0.002	0.15
F/G	4.90	3.50	0.305	0.03
CV of gain, %	5.79	4.58	0.502	0.10
d 0 to 42				
ADG, lb	1.11	1.37	0.063	0.02
ADFI, lb	3.81	3.81	0.001	0.91
F/G	3.70	2.92	0.210	0.03
CV of gain, %	5.18	4.77	0.366	0.45

[a]Each value is the mean of 8 replications, with 10 pigs (initially 155 lb) per pen.
[b]Pens that were fed twice daily received feed at 07:00 and 15:00 hours; Pens that were fed 6 times a day received feed at 07:00, 08:00, 09:00, 15:00, 16:00, and 17:00 hours, respectively.
[c]Feed drops were adjusted every 14 d, based on the average weight of pigs.