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Summary and Implication

*An experiment was conducted to determine the effect of dietary feather meal (**FM**, 0 and 20%) and space allocation (8.3 [**UC**] and 6.2 [**C**] ft²/pig) on growth and carcass characteristics of barrows. Control barrows (0% FM and UC) had 10% higher ADFI than gilts (0 % FM and UC), but only 2.6% greater ADG. Crowded barrows fed 20% FM diet from 165 lb to slaughter had decreased ADG and ADFI compared to control barrows. Crowded barrows fed a diet with no FM had a 4.9% reduction in ADFI compared to control barrows, and crowded barrows fed 20% FM diet had an ADFI (8.3% reduction compared to control barrows) similar to gilts. Gilts had improved feed efficiency compared to barrows. Control barrows reached market weight 7 days earlier than gilts, crowded barrows, and crowded barrows fed a 20% FM diet. Control barrows and gilts had similar average daily lean gain while crowded barrows fed 20% FM from 165 lb to slaughter had a decreased average daily lean gain. Gilts had less backfat and larger loin eye area than barrows on all treatments. Gilts also had a higher primal cut percentage and carcass lean percentage than barrows. Crowded barrows had a higher dressing percentage than uncrowded barrows. The combination of crowding and feeding feather meal reduced growth of barrows to a rate similar to gilts, but the improvements in backfat and carcass lean percentage observed previously by feeding feather meal to barrows were not observed in this study. Increasing stocking density is an effective method to decrease growth rate of barrows.*

Introduction

As more producers adopt all-in-all-out (**AIAO**) systems, the difference in growth rate between barrows and gilts is a concern. Barrows typically eat more feed, grow faster and reach market weight 7 to 10 days sooner than litter-mate gilts. Because barrows and gilts generally have similar lean growth potential in the finishing phase, barrows' greater feed intake results in fatter carcasses compared to gilts at the same live weight. Producers may be able to improve profitability if growth rate and carcass leanness of barrows can be modified to be similar to those of gilts. These modifications in barrows will improve pig flow in AIAO systems. Transportation costs and packer sort loss also may be reduced. Barrows with improved carcass leanness may be more profitable than typical fatter barrows. Our goal was to reduce daily gain of barrows to that of gilts without changing their daily lean gain, which should result in them having less backfat depth and leaner carcasses. Our previous studies have demonstrated that feather meal (a high-protein, low energy feed ingredient) decreased feed intake of finishing barrows, reduced carcass backfat depth and improved carcass leanness of finishing barrows. This article describes an experiment that was conducted to examine the interaction of space allocation and addition of feather meal to the diet on growth performance and carcass characteristics of barrows.

Procedures

Two hundred and fifty-five crossbred high-lean gain potential feeder pigs (210 barrows and 45 gilts with an average weight of 80 lb) were selected from the University of Nebraska Swine Research Unit herd. All pigs were weighed and assigned randomly to the experimental treatments on the basis of five weight outcome groups. Within outcome group, barrows were randomly assigned to one of four treatments and gilts were designated as the control group.

The experiment was conducted at the University of Nebraska Swine Research Unit at Mead. The pigs were housed in a partial slatted, single-wide, naturally ventilated barn with a deep pit. One nipple drinker and four feeder spaces were provided in each 5 × 16 ft pen with a total of 5 pens per treatment combination. Water sprinklers were used for summer heat relief. The feather meal was rendered from turkey feathers and determined by analysis to contain 84% crude protein, 93% dry matter, and 1.5% lysine.

The gilts (**CG**) were fed diets containing 0% FM and were housed 9 pigs per pen (8.3 ft²/pig). Experimental treatments for barrows were diets containing 0 or 20% feather meal and one of two space allocations (8.3 and 6.2 ft²/pig). Barrows with 8.3 (UC) or 6.2 (C) ft²/pig had 9 or 12 pigs per pen, respectively. Barrows assigned to the 0% feather meal treatments (**F0C** and **F0UC** treatments) were fed diets with no FM from approximately 80 lb to slaughter.

Table 1. Composition of experimental diets.

	80 to 135 lb		135 to 190 lb			190 to 245 lb		
Ingredient, %	Gilt	Barrow	Gilt	Barrow	20% FM[a]	Gilt	Barrow	20% FM[a]
Corn	73.65	76.45	77.90	81.50	60.00	82.85	85.65	65.00
Soybean meal, 46.5% CP	23.80	20.95	19.70	16.05	13.50	14.85	12.00	8.60
Feather meal	—	—	—	—	20.00	—	—	20.00
Tallow	—	—	—	—	4.10	—	—	4.10
Premix[b]	2.55	2.60	2.40	2.45	2.40	2.30	2.35	2.30
Formulated composition[c]								
CP, %	17.20	16.60	15.60	14.20	28.00	13.80	12.70	26.10
Ca, %	.54	.54	.50	.49	.50	.45	.45	.45
P, %	.48	.48	.43	.43	.43	.40	.40	.40
ME, Mcal/lb	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
Amino acids, %								
Lysine	.91(.78)[d]	.88(.71)	.79(.68)	.69(.59)	.86(.68)	.66(.56)	.58(.49)	.73(.56)
Tryptophan	.20(.18)	.20(.15)	.18(.16)	.15(.14)	.21(.18)	.15(.13)	.13(.11)	.18(.15)
Threonine	.66(.56)	.64(.46)	.60(.50)	.54(.45)	1.01(.84)	.52(.44)	.47(.40)	.94(.78)
Methionine + cystine	.60(.53)	.59(.48)	.56(.49)	.52(.46)	1.22(.96)	.51(.45)	.48(.42)	1.17(.92)

[a]Feather meal (FM) diet started the week the average pen weight was 165 lb or greater.
[b]The premix contained limestone, dicalcium phosphate, salt, vitamins, and minerals.
[c]CP = crude protein; Ca = calcium; P = phosphorus; ME = metabolizable energy.
[d]The values in parentheses are true ileal digestible amino acid percentages in the diet based on NRC values (1998).

Table 2. Performance and carcass criteria of barrows and gilts.

	Treatment[a]					CG vs	CG vs	UC[b] vs	0FM vs
Item	CG	F0C	F0UC	F20C	F20UC	F0UC	F20C	C	20FM
Pig Weight, lb									
Initial	80.6	80.8	81.1	80.2	80.8	NS[c]	NS	NS	NS
Final	242.0	239.6	240.1	236.3	240.5	NS	<.06	NS	NS
Growth Performance									
ADG, lb[d]	1.62	1.59	1.66	1.57	1.62	NS	NS	< .05	NS
ADFI, lb	5.10	5.35	5.61	5.18	5.46	< .01	NS	< .01	< .05
Gain/Feed	.318	.298	.297	.302	.298	< .01	< .05	NS	NS
Days to market	99.8	99.8	92.8	99.8	98.4	< .01	NS	< .05	
NS									
DLG, lb/d	.65	.61	.64	.60	.60	NS	<.05	NS	NS
Backfat[e] at d1,in	.30	.32	.31	.32	.31	< .05	< .05	NS	NS
Backfat at d90, in	.70	.78	.78	.80	.79	< .05	< .01	NS	NS
Carcass									
Hot carcass, lb	184.4	183.9	181.5	180.4	180.6	NS	NS	NS	NS
Dressing %	76.2	76.7	75.6	76.4	75.1	NS	NS	< .01	NS
Lean %[f]	51.59	49.22	49.22	49.32	49.10	< .01	< .01	NS	NS
Primal cut %	41.41	39.97	39.22	38.97	38.71	< .05	< .05	NS	NS

[a]CG = control gilts; F0C = crowded barrows fed 0% feather meal, F0UC = uncrowded barrows fed 0% feather meal, F20C = crowded barrows fed 20% feather meal, and F20UC = uncrowded barrows fed 20% feather meal.
[b]UC = F0UC + F20UC; C = F0C + F20C; 0FM = F0UC + F0C; 20FM = F20UC + F20C.
[c]Significance of main effect of treatments. NS = not significant.
[d]ADG = average daily gain; ADFI = average daily feed intake; DLG = daily lean gain.
[e]Determined by real-time ultrasound scan.
[f]Containing 5 % fat.

Barrows assigned to the 20% feather meal treatments (**F20C** and **F20UC** treatments) were fed diets with no feather meal until 165 lb body weight and subsequently were fed diets containing 20% feather meal to slaughter. The control barrow group (**F0UC**) served as a benchmark to evaluate the effect of treatments. The CG group served as a benchmark to evaluate the overall performance of barrows versus gilts.

All diets in each phase were formulated to contain the same metabolizable energy (Table 1). Diets were formulated to meet or exceed the NRC (1998) requirements for high-lean gain barrows and gilts. The diets containing 20% feather meal were formulated to have the same percentage of true ileal digestible lysine as diets fed to gilts because we anticipated that barrows fed these diets would have feed intake similar to that of gilts.

Real-time ultrasound scans were performed at beginning and day 90 of the experiment to determine the backfat depth of pigs. Pens of pigs were slaughtered the week the average pen weight was 236 lb or greater. Carcass

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characteristics were measured on individually identified pigs at slaughter using total body electrical conductivity (TOBEC) at SiouxPreme Packing Co., Sioux Center, Iowa.

Results and Discussion

There were no interactions between effects of feather meal and space allocation for any of the performance variables. Control barrows (F0UC) consumed 10% more feed ($P < .05$) and grew 2.5% faster than gilts (Table 2). Gilts needed 7 additional days ($P < .05$) to reach market weight and had better feed efficiency ($P < .05$) than control barrows. Control barrows and gilts had similar daily lean gain, but control barrows had greater backfat depth at 90 days ($P < .05$). Gilts had higher ($P < .05$) total carcass lean percentages and primal cut percentages than control barrows. Crowded barrows fed 20% FM diet from 165 lb to slaughter (F20C) had 8.3% less feed intake ($P < .05$) and grew 5.7% slower ($P < .05$) than control barrows, but their ADFI and ADG were similar to control gilts ($P > .1$) and they reached market weight at the same rate as gilts. Barrows consuming the F20C treatment also had lower daily lean gain than control barrows and gilts (.60, .64, and .65 lb/day, respectively) and greater backfat depth than gilts ($P < .05$). The carcass characteristics of crowded barrows fed 20% FM were similar to control barrows and both were fatter ($P < .05$) than control gilts.

Barrows fed no FM (F0C and F0UC) had ADG similar to gilts (Table 2). Barrows fed the 20% FM diet had less ADFI ($P < .05$) compared to barrows fed no FM. Other performance traits of barrows fed 20% FM were not different than barrows fed no FM. Gilts had better feed efficiency than barrows ($P < .05$) regardless of whether barrows were fed FM. Barrows fed 20% FM diets had reduced daily lean gain ($P < .05$) compared to gilts, but their lean gain did not differ from that of barrows fed no FM. Gilts had less backfat depth and leaner carcasses than barrows ($P < .05$), and there was no difference in carcass characteristics for barrows fed 0% and 20% FM diets. While there was no effect of FM on ADG and ADFI, daily lean gain of barrows fed the 20% FM diet was reduced compared to gilts ($P < .05$).

Crowded barrows had decreased ADG and ADFI ($P < .05$) compared to uncrowded barrows and needed more days ($P < .05$) to reach market weight. Gilts had an 8.4% reduction in ADFI and 7.1% better feed efficiency compared to uncrowded barrows ($P < .05$). Although crowded barrows reached market weight at the same time as gilts, they had lower daily lean gain ($P < .05$). Uncrowded barrows also tended to have lower daily lean gain than gilts ($P = .1$). Restricting space did not improve barrows' carcass leanness. Gilts had less backfat depth, higher carcass lean percentages, and greater primal cut percentages ($P < .05$) than barrows regardless of the space allocation.

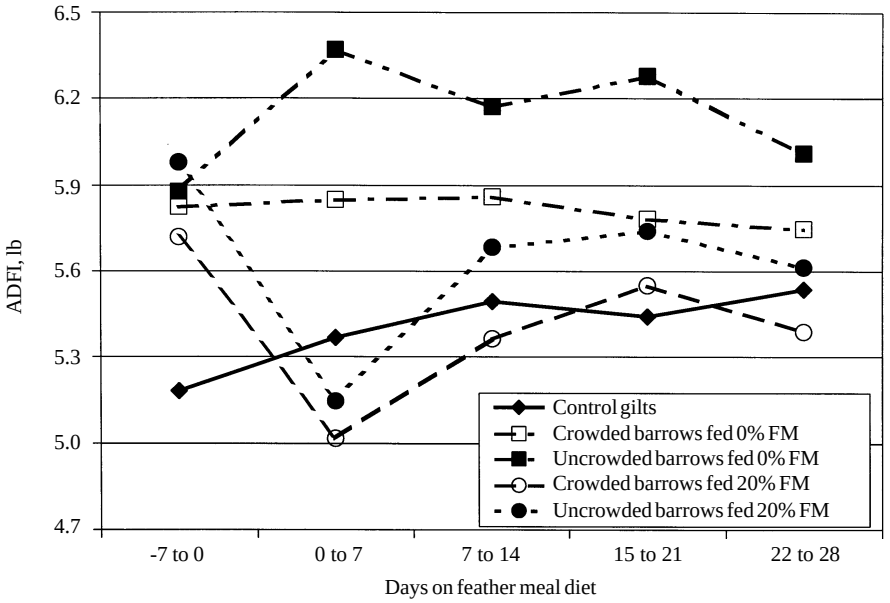

Figure 1. Change in Feed Intake due to Dietary Feather Meal Addition.

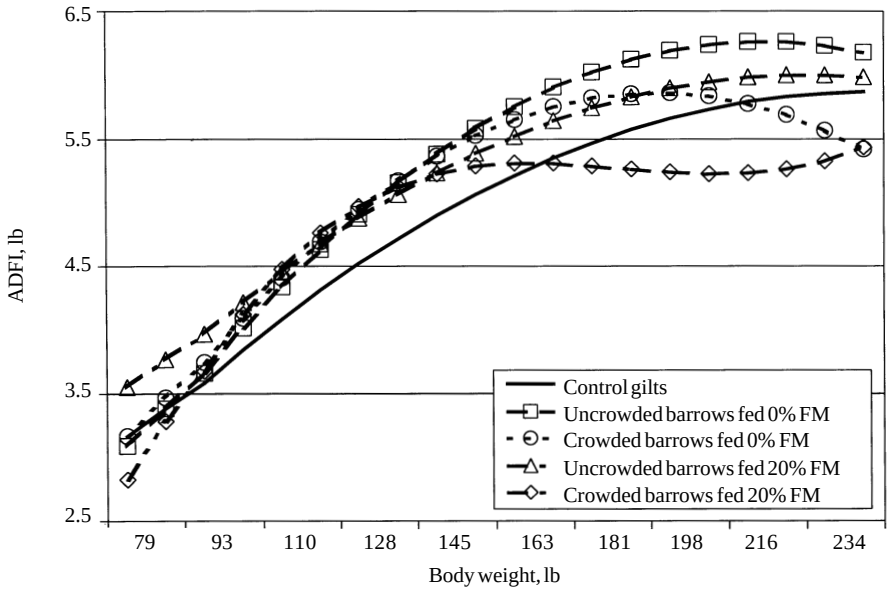

Figure 2. Effect of Experimental Treatments on Daily Feed Intake - data from Table 3.

Crowded barrows had higher dressing percentage ($P < .05$) than uncrowded barrows. The possible explanation for this improvement may be that reduction in feed intake reduced the size of organs involved in digestion and metabolism.

Average daily feed intake during the first week barrows were fed the 20% FM diet was less than that of gilts (Figure 1). The crowded barrows that received a 20% FM diet (F20C) had a 26.9% reduction in ADFI compared to control barrows and 7% reduction in ADFI compared to control gilts. From the second to fourth week after switching to FM diet, the ADFI of crowded barrows fed the 20% FM diet was similar to gilts. This change in ADFI is similar to our previous research trials in which ADFI started to increase beginning two weeks after barrows were fed a FM diet.

Uncrowded barrows (F0UC and F20UC) had higher ADFI than gilts from 80 to 240 lb body weight (Figure 2). Crowded barrows fed no FM started to have ADFI less than control barrows when their body weight was 141 lb and started to have ADFI less than gilts when their body weight was 216 lb. Crowded barrows fed 20% FM diet had ADFI lower than gilts when they were switched to FM diet at 165 lb body weight and then they had very constant ADFI until slaughter. Based on these regression equations (Table 3), crowded barrows fed 20% FM diet had 10.8% lower ADFI than gilts and 19.7% lower ADFI than control barrows at 220 lb body weight. This suggests that the reduction in the barrows' ADFI may have resulted in decreased intake of one or more nutrients which were critical for lean growth from 165 lb to slaughter. Therefore, protein synthesis may have decreased due to insufficient nutrient intake and energy not used for protein synthesis was stored as body fat.

Table 3. Regression equation of ADFI on body weight for each dietary treatment.

	Treatment[a]				
Item	CG	F0C	F0UC	F20C	F20UC
a[b]	-.028830[c]	-.809826[d]	-.697647[c]	-3.814061[d]	.124939[c]
b	.048661[d]	.078336[d]	.071218[d]	.223488[d]	.049956[d]
c	-.000220[d]	-.000442[d]	-.000358[d]	-.002646[d]	-.000240[d]
d	——	——	——	.000010305[d]	——
R square	.90	.90	.77	.80	.86

[a]CG = control gilts; F0C = crowded barrows fed 0% feather meal, F0UC = uncrowded barrows fed 0% feather meal, F20C = crowded barrows fed 20% feather meal, and F20UC = uncrowded barrows fed 20% feather meal.
[b]Equation: $Y = a + bx + cx^2 + dx^3$; Y = ADFI, kg; x = body weight, kg.
[c]$P > .1$.
[d]$P < .01$.

Thus, a possible explanation for no reduction in barrows' backfat depth when they consumed less feed may be an insufficient nutrient intake which was important for amino acid utilization and protein synthesis. This observation of a reduction in ADFI for crowded barrows fed 20% FM diet supports our explanation for the decreased daily lean gain of crowded barrows fed 20% FM diet because the barrows' ADFI was much lower than we expected it to be. While the 20% FM diet was formulated to contain the same percent of ileal digestible lysine as the gilt's estimated requirement, we might have underestimated the barrows' nutrient requirement when their ADFI was similar to that of gilts. In fact, we did underestimate the nutrient requirements for crowded barrows fed the 20% FM diet from 165 lb to slaughter because their ADFI was lower than that of control gilts.

Conclusion

Addition of 20% feather meal to the diet reduced barrows' ADG 2.5% and ADFI 3% when fed from 165 lb body weight to slaughter, while crowding reduced barrows' ADG 3.8% and ADFI 4.9% from 80 lb to slaughter. The combination of dietary FM and space allocation treatment reduced barrow's overall ADFI to a level similar to gilts. The reduction was due to a 26.9% reduction in ADFI after barrows were switched to feather meal diet at 165 lbs body weight. Their ADFI remained consistent from then to slaughter. But the rate of lean gain of crowded barrows fed the 20% FM diet also was decreased. These data suggest crowding was more effective in decreasing barrows' growth rates than dietary feather meal additions.

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