EFFECTS OF INCREASING MEAT AND BONE MEAL ON FINISHING-PIG GROWTH PERFORMANCE

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Summary

A total of 156 finishing pigs (72 barrows and 84 gilts, initially 110 lb) were used to determine the effects on growth performance of increasing meat and bone meal. Pigs were housed in an environmentally regulated finishing building, with two pigs per pen. There were six pens of barrows and seven pens of gilts per treatment. Pigs were blocked by initial weight and sex, and then allotted to one of six dietary treatments. The dietary treatments were based on corn-soybean meal, were formulated on a true-ileal-digestible (TID) lysine basis, and were fed in three phases. In each phase, diets contained 0, 2.5, 5.0, 7.5, 10.0, or 12.5% porcine meat and bone meal. The diets were formulated to 0.85, 0.70, and 0.57% TID lysine in phases 1, 2, and 3, respectively, slightly less than the pig's anticipated requirements, so that if the amino acid digestibility of meat and bone meal was different than typical values, changes in growth performance could be observed. Increasing meat and bone meal increased ADG (quadratic, $P<0.02$), decreased ADFI (linear, $P<0.02$), and improved F/G (quadratic, $P<0.01$). Pigs fed 2.5 or 5.0% meat and bone meal had the best ADG and F/G; as meat and bone meal increased to higher concentrations, however, ADG and F/G decreased and were similar to those of pigs fed the control diet. Because the diets were formulated with slightly less than the pig's anticipated requirements, the results suggest that the meat and bone meal used was relatively high quality and contained greater digestible amino acids than expected. These results suggest that porcine meat and bone meal is a suitable replacement for soybean meal.

(Key Words: Meat and Bone Meal, Finishing Pigs, Pigs.)

Introduction

Meat and bone meal is potentially an important protein source and feed ingredient for swine because of its amino acid profile and high concentration of calcium and phosphorus. It is currently of special interest for two reasons. First, recent changes in USDA regulations regarding the use of animal by-products have resulted in dramatic fluctuations in the price of meat and bone meal. Second, high soybean-meal prices in 2004 have encouraged producers and feed manufacturers to search for alternative protein sources to keep feed costs low.

Because of possible variation in meat and bone meal composition and nutritional quality, current research is needed to evaluate the effects of feeding meat and bone meal in swine

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diets. Therefore, our objective was to evaluate the effects of increasing porcine meat and bone meal as a partial replacement for soybean meal in finishing pig diets.

Procedures

One hundred fifty-six pigs (72 barrows and 84 gilts; PIC L326 × C22) averaging 110 lb were used in this study. Pigs were housed in an environmentally regulated finishing building, with two pigs per pen and six pens (5 × 5 ft) of barrows and seven pens of gilts per treatment in a randomized complete-block design. Pigs were blocked by initial weight and sex, and then randomly allotted to one of the six dietary treatments. Feed and water were provided ad libitum.

There were six dietary treatments fed in three phases. Each phase consisted of: negative control with no meat and bone meal, and the control diet with added 2.5, 5.0, 7.5, 10.0, or 12.5% meat and bone meal. All diets were based on corn-soybean meal and were formulated on a true-ileal-digestible (TID) lysine basis. Phase 1 (110 lb to 145 lb) diets were formulated to contain 0.85% TID lysine. Phase 2 (145 lb to 211 lb) diets were formulated to contain 0.70% TID lysine. Phase 3 (211 lb to 270 lb) diets were formulated to contain 0.57% TID lysine. The experimental diets were formulated with slightly less than the pig's anticipated requirements, so that if the amino acid digestibility of meat and bone meal was different than typical values, changes in growth performance could be observed. Because meat and bone meal is relatively low in tryptophan, synthetic tryptophan was added in phase 2 and 3 diets to ensure that it would not be limiting to pig performance.

Individual pig weights were taken, and feed disappearance was measured every 14 d to calculate ADG, ADFI, and F/G. The experiment was conducted from February to April at the Kansas State University Swine Teaching and Research Center.

Several samples of porcine meat and bone meal used in the experimental diets were taken, homogenized, and sub-sampled for nutrient analysis (Table 1). In addition, the calculated values used for diet formulation are also presented in Table 1.

Results and Discussion

The meat and bone meal used had more crude protein and crude fat, but less calcium and phosphorus, than suggested NRC values (Table 1). Although crude protein concentration was higher than expected, analyzed total amino acid concentrations were only slightly higher than the NRC (1998) values used in diet formulation.

Adding 2.5 or 5.0% meat and bone meal increased ADG (quadratic, $P<0.02$), whereas feeding greater than 5.0% resulted in ADG similar to that of pigs fed the control diet. Increasing meat and bone meal also improved F/G (quadratic, $P<0.01$) over that of pigs fed the control diet, and decreased ADFI (linear, $P<0.02$). But the greatest decrease in ADFI was observed in pigs fed greater than 5.0% meat and bone meal.

The meat and bone meal used in this study seemed to be relatively high quality. The crude protein concentration was higher than anticipated, whereas calcium and phosphorus values were lower. This may reflect a slightly different ratio of muscle and fat versus bone tissue in its manufacturing. Because diets were formulated with less than the pig's requirements, the increase in ADG was possibly influenced by the amino acid digestibility of the meat and bone meal used in this trial. Replacing a portion of soybean meal with the meat and bone meal used in this experiment had no negative effect on pig performance.

Table 1. Nutrient Composition of Meat and Bone Meal (As-fed Basis)

Nutrient	Meat and Bone Meal[a]	NRC Calculated Values[b]
DM, %	94.24	93.00
CP, %	54.28	51.50
Ash, %	24.47	---
Calcium, %	7.83	9.99
Phosphorus, %	4.18	4.98
GE, kcal/lb	1,858	---
Amino Acids, %:		
Arginine	3.66	3.45
Histidine	0.97	0.91
Isoleucine	1.35	1.34
Leucine	3.06	2.98
Lysine	2.55	2.51
Methionine	0.67	0.68
Phenylalanine	1.67	1.62
Threonine	1.62	1.59
Tryptophan	0.32	0.28
Valine	2.09	2.04

[a]Values represent the means of one sample analyzed in duplicate.
[b]Typical experimental composition of meat and bone meal as listed in the National Research Council's Nutrient Requirements for Swine. These values were used in actual diet formulation.

Table 2. Phase 1 Diet Composition (As-fed Basis)[a]

	Meat and Bone Meal, %[b]					
Ingredient, %	0	2.5	5	7.5	10	12.5
Corn	75.81	76.14	76.36	75.99	75.24	74.54
Soybean meal, 46.5% CP	21.30	19.40	17.55	15.70	13.95	12.15
Meat and bone meal	---	2.50	5.00	7.50	10.00	12.50
Monocalcium phosphate, 21% P	1.05	0.50	---	---	---	---
Limestone	1.03	0.65	0.28	---	---	---
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.13	0.13	0.13	0.13	0.13	0.13
Trace mineral premix	0.13	0.13	0.13	0.13	0.13	0.13
Tylan 40	0.05	0.05	0.05	0.05	0.05	0.05
L-Tryptophan	---	---	---	---	---	---
Lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis						
Total lysine, %	0.96	0.96	0.97	0.98	0.99	0.99
TID lysine [c]	0.85	0.85	0.85	0.85	0.85	0.85
Isoleucine:lysine ratio	70	69	68	67	66	65
Leucine:lysine ratio	163	163	163	163	162	162
Methionine:lysine ratio	29	29	30	30	30	30
Met & Cys:lysine ratio	60	60	59	59	59	59
Threonine:lysine ratio	62	62	62	62	62	63
Tryptophan:lysine ratio	19	19	18	17	17	16
Valine:lysine ratio	80	81	81	81	82	82
ME, kcal/lb	1,506	1,507	1,507	1,498	1,485	1,472
Protein, %	16.3	16.8	17.2	17.6	18.0	18.4
Ca, %	0.68	0.68	0.69	0.83	1.07	1.31
P, %	0.58	0.58	0.58	0.69	0.80	0.92

[a]Diets fed in meal form.
[b]Fed to pigs from 110 lb to 145 lb.
[c]True-ileal-digestible lysine.

Table 3. Phase 2 Diet Composition (As-fed Basis)[a]

	Meat and Bone Meal, %[b]					
Ingredient, %	0	2.5	5	7.5	10	12.5
Corn	82.10	82.40	82.57	82.00	81.29	80.59
Soybean meal, 46.5% CP	15.3	13.40	11.55	9.75	7.95	6.15
Meat and bone meal	---	2.50	5.00	7.50	10.00	12.50
Monocalcium phosphate, 21% P	0.85	0.35	---	---	---	---
Limestone	1.00	0.60	0.13	---	---	---
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.10	0.10	0.10	0.10	0.10	0.10
Trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10
Tylan 40	0.05	0.05	0.05	0.05	0.05	0.05
L-Tryptophan	---	---	---	---	0.01	0.01
Lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis						
Total lysine, %	0.79	0.80	0.81	0.81	0.82	0.83
TID lysine [c]	0.70	0.70	0.70	0.70	0.70	0.70
Isoleucine:lysine ratio	69	68	67	66	65	71
Leucine:lysine ratio	178	178	179	178	177	177
Methionine:lysine ratio	31	32	32	32	33	33
Met & Cys:lysine ratio	64	64	64	64	64	63
Threonine:lysine ratio	63	63	64	64	64	64
Tryptophan:lysine ratio	19	18	17	16	16	16
Valine:lysine ratio	83	84	85	85	85	85
ME, kcal/lb	1,511	1,512	1,512	1,500	1,487	1,474
Protein, %	14.1	15.5	15.0	15.4	15.8	16.2
Ca, %	0.61	0.61	0.61	0.81	1.05	1.29
P, %	0.51	0.52	0.56	0.67	0.78	0.89

[a]All diets fed in meal form.
[b]Fed to pigs from 145 lb to 211 lb.
[c]True-ileal-digestible lysine.

Table 4. Phase 3 Diet Composition (As-fed Basis)[a]

	Meat and Bone Meal, % [b]					
Ingredient, %	0	2.5	5	7.5	10	12.5
Corn	87.49	87.79	87.86	87.18	86.48	85.77
Soybean meal, 46.5% CP	10.10	8.25	6.40	4.60	2.80	1.00
Meat and bone meal	---	2.50	5.00	7.50	10.00	12.50
Monocalcium phosphate, 21% P	0.70	0.20	---	---	---	---
Limestone	1.00	0.55	0.03	---	---	---
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.08	0.08	0.08	0.08	0.08	0.08
Trace mineral premix	0.08	0.08	0.08	0.08	0.08	0.08
Tylan 40	0.05	0.05	0.05	0.05	0.05	0.05
L-Tryptophan	---	---	---	0.01	0.01	0.02
Lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis						
Total lysine, %	0.65	0.66	0.66	0.67	0.68	0.69
TID lysine [c]	0.57	0.57	0.57	0.57	0.57	0.57
Isoleucine:lysine ratio	70	69	67	66	64	71
Leucine:lysine ratio	198	198	198	197	197	196
Methionine:lysine ratio	34	35	35	36	36	36
Met & Cys:lysine ratio	71	71	71	70	70	69
Threonine:lysine ratio	65	65	66	66	66	66
Tryptophan:lysine ratio	18	17	16	16	16	16
Valine:lysine ratio	87	88	89	89	90	90
ME, kcal/lb	1,516	1,516	1,515	1,502	1,489	1,476
Protein, %	12.1	12.6	13.0	13.4	13.8	14.2
Ca, %	0.56	0.56	0.56	0.79	1.03	1.28
P, %	0.46	0.47	0.54	0.65	0.76	0.87

[a]All diets fed in meal form.
[b]Fed to pigs from 211 lb to 270 lb.
[c]True-ileal-digestible lysine.

Table 5. Growth Performance of Finishing Pigs Fed Increasing Meat & Bone Meal[a]

	Meat & Bone Meal, %							Probability, P <		
Item	0	2.5	5.0	7.5	10.0	12.5	SE	Linear	Quadratic	Control vs M & B Meal
ADG, lb	2.19	2.38	2.32	2.22	2.24	2.19	.61	0.19	0.02	0.09
ADFI, lb	6.65	6.85	6.72	6.45	6.45	6.45	.14	0.02	0.73	0.61
F/G	3.03	2.88	2.90	2.92	2.90	2.95	.54	0.28	0.01	0.01

[a]A total of 156 pigs (72 barrows, 84 gilts; PIC L326 × C22; initially 110 lb), with two pigs per pen and 13 pens per treatment.