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Effects of varying sorghum grain soybean meal ratios and added methionine on swine gains, feed efficiency and carcass composition and quality

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Effects of Varying Sorghum Grain
Soybean Meal Ratios and Added
Methionine on Swine Gains, Feed
Efficiency and Carcass Composition
and Quality

D.H. Kropf, L.H. Kasten, B.A. Koch and R.H. Hines

Limited work is available on proper protein levels in swine rations when sorghum grain is a major ration component.

Remarkable improvement has been made in gaining ability, feed conversion and muscling in swine. Because of continued improvements in these characteristics due to breeding and selection, we need to periodically re-evaluate the requirements for protein and amino acid levels in swine rations.

A deterioration in muscle quality (color, firmness and marbling) seems to be associated with production of lean pork. This prompted a detailed study of muscle quality, carcass composition, feed/gain ratio and gain rate as affected by varying ratios of sorghum grain and soybean meal, as well as added methionine, in swine rations.

Procedure

Pelleted, fortified sorghum grain - soybean meal rations containing 13, 16, 20 and 20% protein plus methionine made up the 4 treatments (Table 1). The amounts of dicalcium phosphate and limestone were varied to maintain similar levels of calcium and phosphorus at all of the protein levels. Protein level was not adjusted as pigs became heavier.

Calculated methionine and lysine ration levels and requirements for the 4 treatments are presented in Table 2. The lysine to methionine ratio was wider in the higher protein rations, therefore methionine was added to the high protein ration. Methionine and lysine are both amino acids, the so-called building blocks of protein, and the proper ratio of one required amino acid to another is important in formulating swine rations. Table 2 also shows the lysine and methionine requirements for weanling and finishing swine. Another amino acid, cystine, can supply up to 40% of methionine needs and this fact was considered in calculating the methionine requirements.

A total of 64 Duroc pigs, 4 barrows and 4 gilts from each of 8 litters, was selected and 1 barrow and gilt from each litter were assigned to each ration. Half of the litters were used in a winter trail begun on October 25, 1966, and half in a spring trial begun on February 7, 1967.

All pigs were individually taken off test and slaughtered in the Animal Science and Industry meat laboratory when reaching about 210 pounds live weight.

Carcass and muscle quality information was collected by standard methods.

TABLE 1. EFFECTS OF VARYING SORGHUM GRAIN-SOYBEAN MEAL RATIOS AND ADDED METHIONINE.
COMPOSITION OF RATIONS (1000 LB.)

Ingredients	lb.	gm.	lb.	gm.	lb.	gm.	lb.	gm.
Sorghum grain ^a	870		770		670		670	
Soybean Meal	100		200		300		300	
Dicalcium phosphate	10		8		6		6	
Limestone	10		10		11		11	
Salt	5		5		5		5	
Trace Mineral premix ^b	0.5		0.5		0.5		0.5	
Vitamin A ^c		150		150		150		150
Vitamin D ^d		10		10		10		10
Vitamin premix ^e		150		150		150		150
Vitamin B ₁₂		100		100		100		100
Aureomycin ^g		454		454		454		454
Methione ^h		---		---		---		646
Sorghum grain		1180		2088				1898

^a In an effort to stop chewing of teeth, salivation and scouring, 5 percent alfalfa replaced sorghum grain in second trial on March 8, 1967 (about 4 weeks after start of Trial 2).

^b Provides 22.7 mg. manganese, 22.7 mg. iron, 2.27 mg. copper, 11.35 mg. zinc, 6.81 mg. iodine and 227 ug. cobalt per lb. of diet.

^c Provides 1500 I.U. vitamin A per lb. of diet.

^d Provides 150 I.U. vitamin D per lb. of diet.

^e Provides 24.6 mg. choline chloride, 7.9 mg. niacin, 2.6 mg. riboflavin and 5.3 mg. pantothenic acid per lb. of diet.

^f Provides 4.4 ug. vitamin B₁₂ per lb. of diet.

^g Provides 10 mg. aureomycin HCL per lb. of diet.

^h 99% d-l methionine.

TABLE 2. CALCULATED METHIONINE AND LYSINE DIET LEVELS AND REQUIREMENTS
FOR 13, 16 AND 20 PERCENT MILO-SOYBEAN RATIONS

Amino acid	Requirement ^a							Ration Content ^b			
	Weanling pig (30 lb.)			Finishing pig (100 lb.)			Level of dietary protein (%)	13 16 20			20 plus methionine
	13	16	20	13	16	20		13	16	20	
(percent of diet)							(percent of diet)				
Methionine	.43	.50	.57	.32	.37	.43		.213	.249	.286	.428
Methionine x .60	.26	.30	.34	.19	.22	.26		—	—	—	—
Lysine	.64	.74	.87	.53	.62	.72		.554	.823	1.093	1.093

^aValues are either those reported by Becker et al. (1966) or calculated on their assumption that "the need for each amino acid, expressed as a percent of the protein, decreases 1.75 percent (from value at 0 percent protein) per unit increase in percent protein."

^bCalculated from the value reported for the methionine and lysine content of the grain sorghum and soybean meal used in this study. (Appendix 3)

^cBased on the assumption that cystine can supply 40 percent of the total need for methionine.

Results

No significant differences were found between these rations in daily gain, feed intake or feed efficiency for the first 70 days on test, although pigs fed 13% protein seemed to consume more feed daily (Table 3).

Table 3. Effects of Protein Level and Added Methionine
on Swine Feedlot Performance

(Ration Means - 2 trials combined)

Item	13	16	20	20 + meth.
No. of pigs	16	16	16	16
Age at slaughter, days	176.6	176.7	184.7	188.4
Total days on feed	91.3	91.6	100.2	103.3
Live empty slaughter wt. lbs.	198.5	201.0	197.6	198.4
70 day av. daily gain, lbs.	1.46	1.49	1.36	1.39
70 day daily feed intake	4.97	4.66	4.61	4.53
70 day feed/gain ratio	3.41	3.13	3.39	3.26
Total av. daily gain, lbs.	1.56	1.60	1.44	1.46
Total daily feed intake	5.26	5.28	5.11	5.16
Total feed/gain ratio	3.46 ^{ab}	3.33 ^a	3.63 ^c	3.60 ^{bc}
Total daily prot. intake	0.68 ^a	0.85 ^b	1.02 ^c	1.03 ^c
Lb. crude protein/lb. of gain	0.45 ^a	0.54 ^b	0.72 ^c	0.72 ^c

a,b,c, Means on the same line with the same superscript are not significantly different (P<.05).

No letter also indicates no difference.

Table 4. Effects of Protein Level and Added Methionine
on Carcass Characteristics

(Ration Means - 2 trials combined)

Item	Protein level, %			
	13	16	20	20 + meth.
Chilled carcass wt., lbs.	144.2	144.4	141.7	142.0
Dressing %	72.7	71.8	71.7	71.6
Carcass length, in.	28.5	28.6	28.5	28.7
Backfat thickness, in.	1.34	1.26	1.22	1.19
Loin eye area, 10th rib, sq. in.	3.84	3.93	4.02	4.02
% of Carcass				
4 Lean Cuts	55.7	56.3	57.5	57.1
Ham + Loin	37.1	37.8	38.5	38.1
5 Primal Cuts	69.5	69.9	70.6	70.2
Ham loin index	93.6	96.9	97.8	98.9
Kidney wt., gms.	299. ^a	343. ^b	360. ^b	359. ^b

^{a,b} Means on same line with the same superscript are not significantly different (P<.05). No letter also indicates no difference.

Table 5. Effects of Protein Level and Added Methionine
on Muscle Quality and Related Factors
(Ration Means - 2 trials combined)

Item	Protein Level, %			
	13	16	20	20 + meth.
Ham Quality Scores				
Color ^c	2.8	2.8	3.0	3.0
Firmness ^c	2.8	2.8	2.9	2.7
Loin Eye Quality Scores				
Color ^c	2.8	2.8	3.1	3.0
Firmness ^c	2.7	2.7	2.7	2.7
Marbling ^d	23.0 ^a	17.8 ^b	18.2 ^b	19.1 ^b
Shear Force Value, lbs. ^e	6.2	6.5	6.9	6.6
% Expressible Water. ^f	34.6	34.6	34.4	33.6
Total Cooking Loss, % ^g	29.8	30.0	27.8	31.4

a,b Means on same line with the same superscript are not significantly different ($P < .05$).

c Color, Firmness scored using Wisconsin Special Bulletin #9. Higher value means firmer, darker lean.

d Marbling scored by U.S.D.A. beef marbling standards. 17=Modest, 23=Slightly abundant.

e Warner Bratzler shear for cooked $\frac{1}{2}$ in. core from loin chop.

f % Expressible Water using Centrifuge method.

g % Total Cooking Loss for boneless, defatted loin eye muscle sample.

For the entire test period, no significant difference was noted for daily gain or feed efficiency although pigs fed 20% protein (with or without methionine) tended to gain slower and consequently took longer to reach the specified slaughter weight. Daily feed intake was quite similar on all rations, but pigs receiving higher protein rations consumed more protein per day and more protein per pound of gain. Feed to gain ratio was most satisfactory on the 16% and 13% protein rations.

The sorghum grain - soybean meal ratio (protein level) did not significantly affect dressing %, carcass length, backfat thickness, loin eye area; or the proportion of carcass found in the 4 lean cuts, the 5 primal cuts or the ham plus loin (Table 4). Ham-loin index, used in many of our carcass shows to rank carcass meatiness, was not strongly affected by ration. Ham-loin index tends to be lower for the 13% protein group of swine, but differences are small enough so they could be due to errors in collection of this information. Backfat tends to be greater on the lower protein rations, but this small difference would not appear to be worth the extra expense of the higher protein rations.

Kidney weights were greater from pigs fed 16 or 20% protein rations. Kidneys have been shown to increase in size when they have more work to do. In this case, the larger kidneys indicate that dietary protein, above the level that was useable by the pig, was probably being eliminated in the urine as urea.

Color and firmness scores of hams or loins were not affected by sorghum grain - soybean meal ratios. The loin eye marbling score was higher in those pigs fed 13% protein than those receiving 16 or 20% protein rations.

No treatment difference was found in shear value of loin chops (Table 5). Shear value is an objective measure of muscle tenderness so the rations used did not affect tenderness of broiled loin chops.

Expressible water % is a measure of the muscles ability to hold water through such processing steps as heating, freezing and thawing. This important characteristic was not affected by these rations and neither was the closely related factor of cooking loss during broiling.

SUMMARY

Sixty-four pigs were allotted to 4 treatments receiving pelleted fortified rations containing varying sorghum grain - soybean meal ratios so as to supply 13%, 16%, 20% and 20% protein plus 0.142% dl methionine. Pigs were individually slaughtered when they reached about 210 pounds live weight.

The following results were noted:

1. Protein level had no significant effect on daily gain, feed efficiency for the first 70 days on test.

2. Daily gain or feed efficiency over the entire feeding trial was not significantly affected although pigs fed 20% tended to gain more slowly.
3. Daily feed intake was quite similar on all rations, but pigs receiving higher protein rations consumed more protein per day and more protein per pound of gain.
4. Feed to gain ration was most satisfactory on the 16 and 13% protein rations.
5. Ration did not strongly alter carcass composition. Slight reductions in carcass backfat and increases in loin eye size from the higher protein rations would not appear to be worth the extra expense.
6. Color and firmness scores of ham and loin eye muscles were not affected by ration protein level, although loin eye marbling was increased when the 13% protein ration was fed.
7. Tenderness, water holding ability and cooking loss of loin eye muscle was not affected by the varying sorghum grain - soybean meal ratios.