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High-Lysine Corn in Growing-Finishing Swine Rations

Keith E. Gilster and Richard Wahlstrom

The presence of the opaque-2 gene in corn has been found to alter the amino acid pattern of corn protein resulting in a substantial increase in the lysine content. In addition, the tryptophane content of opaque-2 corn is higher than normal corn. Since normal corn is deficient in these two essential amino acids for swine, opaque-2 corn more nearly meets the amino acid requirement of the pig. The remaining amino acids existing in high-lysine corn may be higher or lower than in regular corn but probably do not greatly affect protein quality.

The main advantage of the use of high-lysine corn in swine rations is that less supplemental protein is needed to formulate a ration meeting the requirements of the pig. If opaque-2 corn can be produced at the same cost and with similar yields of present hybrids, a great savings in feed cost could be realized.

The objectives of this experiment were to compare the performance and carcass characteristics of growing-finishing pigs fed rations of normal or opaque-2 corn containing recommended and low levels of protein.

Experimental Procedures

Forty-eight pigs averaging approximately 42 lb. were divided into 12 lots on the basis of sex, weight and ancestry. These lots were then randomly assigned to each of four treatments which were as follows:

1. 16-14%^a protein normal corn ration
2. 16-14% protein opaque-2 corn ration
3. 12-10% protein normal corn ration
4. 12-10% protein opaque-2 corn ration

^a Rations were reduced in protein when a lot averaged approximately 110 lb.

The composition of the rations fed is shown in table 1. Feed and water were provided ad libitum. Waterers and feeders were located in connecting outside pens. The protein and amino acid contents of the regular and high-lysine corn are shown in table 2. These analyses were conducted in cooperation with the Station Biochemistry Department, South Dakota Agricultural Experiment Station. The high-lysine corn was supplied by the Trojan Seed Company, Olivia, Minnesota.

Results

The growth performance data are summarized in table 3. Pigs receiving the normal corn recommended protein ration and high-lysine corn recommended protein ration expressed similar average daily gains of 1.83 lb. and 1.81 lb., respectively. In addition the feed required per lb. of gain was 3.21 lb. for the group fed the normal corn and 3.18 lb. for the group fed the high-lysine corn. Apparently the normal corn supplied adequate lysine and there was no benefit from the additional lysine present in the high-lysine corn ration.

Pigs receiving the normal corn low protein ration gained only 1.31 lb. per day, or a 30% decrease in gain when compared to the pigs gaining 1.70 lb. per day while receiving the high-lysine corn low protein ration. Also, the group fed normal corn required 71 lb. more feed per 100 lb. of gain than the high-lysine corn group. A marked decrease in average daily feed consumption was also observed for the normal corn low protein group. The poor performance of the normal fed group could be attributed, at least in part, to the low lysine content of the rations fed this group. These rations supplied approximately 0.48 and 0.32% lysine while the requirement of the pig is estimated to be about 0.7 and 0.5% during the two periods, respectively. Pigs fed the low protein high-lysine corn ration gained slower and required more feed per lb. of gain than pigs receiving either of the recommended protein rations. This reduction in gain and feed efficiency may have been due to the lower lysine content in the high-lysine corn low protein ration.

The carcass data are summarized in table 4. There was a marked reduction in percent lean cuts, loin eye area and percent protein in the loin eye muscle in carcasses from pigs fed the normal corn low protein ration. In addition, a definite increase in percent fat in the loin eye muscle and a slight increase in backfat was observed in carcasses from the normal corn low protein group.

Although the carcass merit of the remaining three treatments was quite similar, the pigs receiving the high-lysine corn recommended protein diet had a larger loin eye, less backfat, higher percent lean cuts and a reduced percent fat in the loin eye muscle. There were essentially no differences in carcass length between any of the treatments.

It is observed from this and other research that opaque-2 corn will result in improved pig performance when fed in rations containing less protein than recommended for pigs fed normal corn. This response of the pigs to opaque-2 corn is apparently due to the additional lysine content, although it is possible that a higher amount of some of the other essential amino acids is also beneficial.

Summary

Pigs weighing approximately 41 to 43 lb. initially showed a similar rate of gain and feed efficiency when fed 16 to 14% protein rations containing either normal or opaque-2 corn. However, when low protein (12 to 10%) rations were fed, pigs receiving the ration containing opaque-2 corn gained 0.39 lb. per day faster and required 21% less feed per unit of gain than the pigs receiving the normal corn ration. Performance of pigs fed the high-lysine corn low protein ration approached that of pigs fed the higher protein (16 to 14%) rations. Gains were approximately 7% less and the feed requirement was about 6% greater.

Pigs fed the low protein normal corn ration produced carcasses with less lean as evidenced by a smaller loin eye area, a lower percent of lean cuts, a higher amount of backfat and a greater percent of fat in the loin eye muscle.

Table 1. Composition of Rations (Percent)

Ration	To 110 pounds				110 pounds to final weight			
	A	B	C	D	E	F	G	H
Normal corn	77.08	--	88.55	--	83.21	--	94.61	--
Opaque-2 corn	--	77.58	--	89.13	--	83.76	--	95.24
Soybean meal (44.0%)	19.88	19.38	8.31	7.73	13.98	13.43	2.48	1.85
Dicalcium phosphate	1.90	1.89	2.00	2.00	1.70	1.70	1.80	1.80
Ground limestone	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Trace mineral salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vitamin-antibiotic mix ^a	0.14	0.14	0.14	0.14	0.11	0.11	0.11	0.11
Calculated protein, %	16.0	16.0	12.0	12.0	14.0	14.0	10.0	10.0
Calculated lysine, %	0.79	0.93	0.48	0.63	0.63	0.78	0.32	0.49

^a Provided per lb. of ration: 1,500 I.U. of vitamin A, 180 I.U. of vitamin D, 11 I.U. of vitamin E, 2.93 mg. of riboflavin, 5.51 mg. of pantothenic acid, 13.48 mg. of niacin, 14.98 mg. of choline, 5.3 mcg. of vitamin B₁₂ and 20 mg. of tylan in rations A, B, C and D and 7.5 mg. in rations E, F, G and H.

Table 2. Amino Acid Content of Normal and Opaque-2 Corn, Percent (Moisture-Free Basis)

	Normal	<u>Opaque-2</u>
Lysine	0.30	0.52
Histidine	0.31	0.34
Arginine	0.51	0.73
Aspartic acid	0.72	1.06
Threonine	0.42	0.44
Serine	0.54	0.49
Glutamic acid	2.19	2.39
Proline	1.05	1.00
Glycine	0.39	0.53
Alanine	0.88	0.72
Half cystine	0.20	0.23
Valine	0.54	0.56
Methionine	0.08	0.11
Isoleucine	0.40	0.39
Leucine	1.47	0.92
Tyrosine	0.46	0.39
Phenylalanine	0.55	0.48
Protein	9.43	9.66

Table 3. Results of Feeding Opaque-2 Corn to Growing-Finishing Swine

Protein, % ^a	High-lysine		High-lysine	
	Normal 16-14	corn 16-14	Normal 12-10	corn 12-10
No. of pigs ^b	12	12 ^c	11 ^d	12
Avg. init. wt., lb.	41.9	41.4	43.4	41.3
Avg. final wt., lb.	209.8	209.4	207.4	210.7
Avg. daily gain, lb.				
Init. wt., 110 lb.	1.73	1.73	1.25	1.68
110 lb. to final wt.	1.91	1.87	1.37	1.72
Init. wt. to final wt.	1.83	1.81	1.31	1.70
Avg. feed per lb. gain, lb.				
Init. wt. to 110 lb.	2.64	2.59	3.88	2.67
110 lb. to final wt.	3.61	3.65	4.44	3.90
Init. wt. to final wt.	3.21	3.18	4.10	3.39
Avg. daily feed, lb.				
Init. wt. to 110 lb.	4.54	4.46	4.74	4.48
110 lb. to final wt.	6.86	6.79	5.71	6.63
Init. wt. to final wt.	5.86	5.71	5.19	5.73

^a Rations were reduced in protein when a lot averaged approximately 110 lb.

^b Three lots of 4 pigs each per treatment.

^c One pig removed from treatment during the period of 110 lb. to final weight because of a lame condition. Data are not included for that period.

^d One pig removed from treatment due to a chronic illness. Data are not included.

Table 4. Effect of Feeding Opaque-2 Corn on the Carcass Characteristics of Growing-Finishing Swine

Protein, %	High-lysine		High-lysine	
	Normal 16-14	corn 16-14	Normal 12-10	corn 12-10
No. of pigs ^a	11 ^b	11	11	12
Avg. loin eye area, sq. in.	4.98	5.35	3.94	5.17
Avg. backfat, in.	1.15	1.12	1.21	1.16
Avg. length, in.	30.06	30.16	30.27	29.81
Avg. lean cuts, %	48.20	48.95	45.56	48.43
Loin eye muscle ^c				
Avg. moisture, %	72.82	73.56	72.46	73.12
Avg. protein, %	23.02	22.48	20.72	22.73
Avg. fat, %	11.70	7.41	21.05	12.61

^a Three lots of 4 pigs each per treatment.

^b One pig died due to a stress condition prior to slaughter.

^c The loin eye sample evaluated was removed from the longissimus dorsi muscle at the 10th rib.